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Some of the Mechanical Features of the National Cash Register Company's Factory.

In two preceding articles we have shown how radically the factory of the National Cash Register Company at Dayton, O., differs from the ordinary factory in respect of administration and in the features calculated to attract and secure the best service of the best men and women.

In the nature of the case, it cannot differ so much in its purely mechanical features. The principles governing the systematic manufacture of cash registers are, of course, much the same as those which apply to sewing machines, small-arms, typewriters, etc., and the equipment is very similar.

It is to be remembered, however, that, instead of having only one or two men who are engaged in devising improvements, new tools and methods, etc., practically every employé is stimulated to do what he can in this line, and it is a fact that some of the very best ideas now made use of in the manufacturing operations carried on here have come from employés who, under ordinary conditions, would almost certainly not have proposed any ideas, nor thought of attempting to do so.

There is a department of tool designing, whose work it is to design special tools and machinery; but a large part of its work is the complete designing of tools and machinery suggested by more or less crude sketches and descriptions which come through the autographic registers previously mentioned, and otherwise from employés who are not engaged for such work, but are encouraged to do it, nevertheless.

Every proposed mechanical improvement of importance must be approved by the Factory Committee which, it will be remembered, is composed of experts in charge of various departments of the factory, and changes its chairman each month. This committee is found to be progressive yet conservative. Almost anything which may be brought before it will find at least one man, and probably more than one, thoroughly competent to decide upon its merits or demerits. The committee will, in the nature of things, be guided largely by this expert opinion; but, at the same time, every proposition is subject to discussion, and must receive a majority vote; experience showing, however, that the action of the committee is almost always unanimous. No jig or important fixture, for instance, can go onto the shelves of the tool supply department to be used until it has been approved by this committee.

That tools are thoroughly believed in here, is shown by the fact that the tool-making department has a larger number of employés than are in any other department of the works—somewhat over 90.

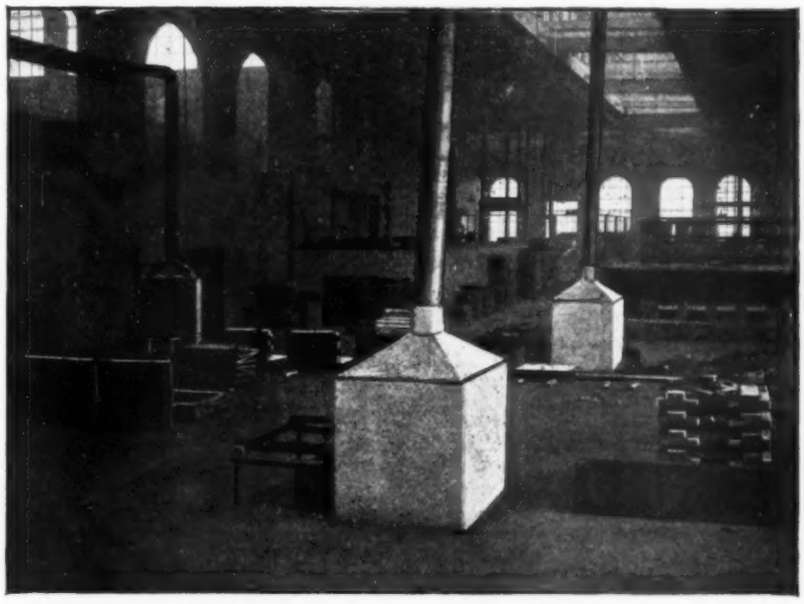

Fig. 1. VIEW IN BRASS FOUNDRY—MOLD SMOKING OVENS.

THE MACHINERY COMMITTEE.

There is in addition a Machinery Committee, consisting of seven members. The chairman and all the other members of this committee, with one exception, are mechanics in charge of various departments of the factory; the exception noted being the purchasing agent. All new machinery purchased must first have the approval of this committee.

This is a very radical departure from the method too often followed in which some foreman simply tries to get the best and most expensive machine he knows of, or one in favor of which he may have some prejudice; while the purchasing agent blindly insists upon buying that machine of the class wanted on which he can get the lowest quotations, blissfully unconscious of the fact that there may be good reasons why one machine should cost twice as much and be worth four times as much as another, called by the same name and of equal weight.

It would obviously be impossible for us to give a complete account of the mechanical features of the factory resulting from this arrangement. It is significant, however, to note that the factory has most of the very latest and most approved appliances and the best machinery.

THE POWER.

The B. & W. water tube boilers are fired by an automatic stoker. Soft coal is burned and a very steady fire is maintained, with a minimum of smoke and little labor. A compound Buckeye engine, 13 and 25 x 30 inches, is direct-connected to a Siemens & Halske 225 kilowatt generator, from which wires are led to motors belted directly to the vari-

ous line shafts, usually at the middle of their length. A smaller engine and dynamo are used exclusively for lighting.

The air blast system of heating and ventilating is used, the air of the buildings being completely changed every 15 minutes. Not only in the engine and boiler rooms, but throughout the factory, it is evident that machinery of all kinds has been selected with discretion and good judgment, and most of the best tool builders are represented here in one or more lines.

On going through the factory, we noticed a good many innovations on usual practice, some of which it is practicable to give an account of.

AN EXTENSION OF THE CHECK SYSTEM.

In the department of tool supply they have in use a recently devised extension of the check system which had been found to work very well. It was devised to overcome a difficulty sometimes experienced when a workman, possibly about to leave the factory, claimed that all tools obtained by him had been returned to the tool room, and yet could not show all his checks. The presumption would be that the missing checks were in place of tools taken out, but among the large number of shelves, pigeon-holes and cupboards it might be considerable of an undertaking to find them, the classification of tools being in some cases of little use as a guide. At the time of our visit to the factory a prize had recently been awarded to E. C. Rhonemus, who is in charge of the tool-supply department, for a plan of overcoming this difficulty. We have before mentioned that each different kind of cash register made here has a distinguishing color assigned to it. In the tool-supply department the tool cases, etc., are designated, by corresponding colors, to assist in the ready classification and finding of any required tool. This fact is made use of in Mr. Rhonemus' scheme, though it is not a necessary feature of it. For each tool and fixture in this department a brass check is provided, and one of these checks is hung up over, or at the side of every tool or fixture when the latter is not in use and is in its place in the tool room. On the check is stamped the name or symbols by which the tool or fixture can be readily identified, and located in the tool cases. When any tool is called for at the window, the workman's check is put in place of the first-named check, and as the tool is handed out, its particular check is placed on a hook which is fixed in a board near the delivery window, which board has a hook for each workman who has checks, and every hook is numbered to correspond to the number of some workman. Thus when for any reason it is desirable to know what tools a workman may have out, an inspection of the brass checks on his pin will give full information on that point, and if his own checks are on the corresponding tools the evidence is complete. It is significant, perhaps, that this scheme was first practically tested with some of the tools most used, by means of temporary checks cut out of card board and marked with a pencil.

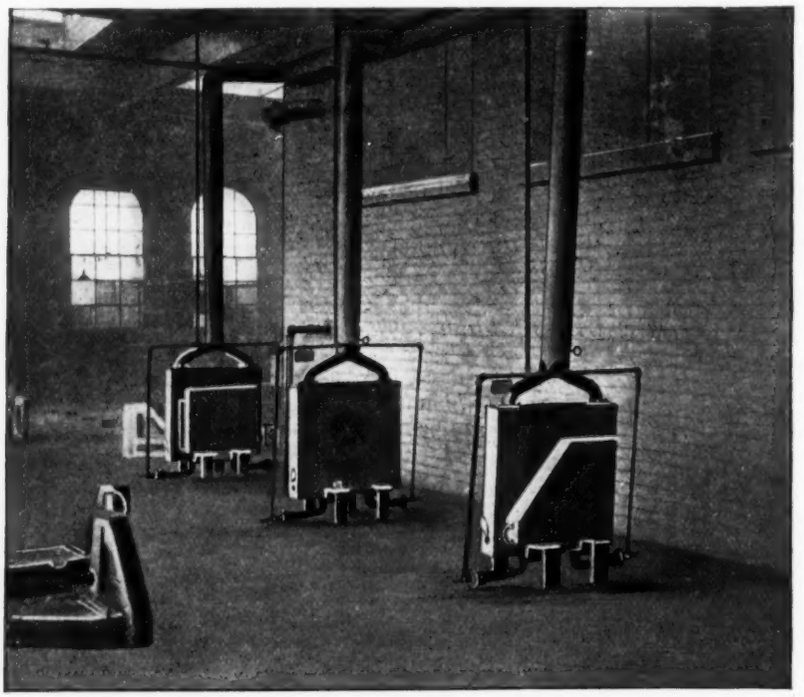

Fig. 2. VIEW IN BRASS FOUNDRY—MOLD DRYING FURNACES.

USE OF COLORED CHECKS.

The colored checks are also used for special purposes. When any of the different committees order any changes in tools a red check is hung on the tool ordered changed, inserting the date that the order was given and adding the warning, "Don't give out, see me." Blue checks are used to signify the length of time a new tool is in this department before it is called for. For instance, a tool may be approved by one of the committees, say January 1, 1897. When this tool is received in the tool supply department, the stamp of approval is put on, it is put into its proper tool case, and one of these blue checks is hung in the same receptacle with the date of approval by the committee inserted on it. If at the expiration of fourteen days the tool has not been called for, the committee is notified of the fact and they take the necessary steps to insure the tool being used. In case any new improvement is about to be put on any register that will by its adoption discontinue the use of any other parts, white checks are put on the tool for these parts, and on the checks is the following warning, "To be abandoned about May 1, 1897," for instance. Thus every one interested, having his attention called to this fact, is careful not to machine up too many of the "to be abandoned parts."

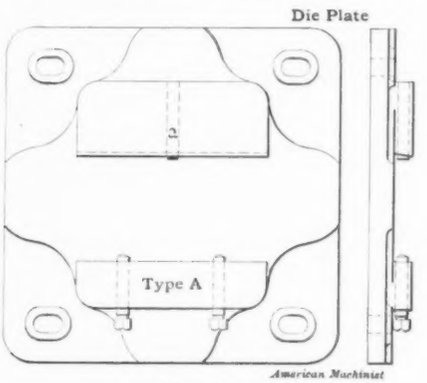

Fig. 3

LOCK FOR DIES.

THE BRASS FOUNDRY.

Brass molding is an important part of the work here, and the brass foundry is a model of its kind. James McTaggart, who for some years was in charge of the Yale & Towne foundry, is foreman here, and the only point in which he considers this foundry to be otherwise than all that could be desired, is that some portions of the roof are too low to permit at all times the best possible ventilation. It is quite certain, however, that even in this respect, it is far superior to most brass foundries, while in all other respects it is difficult to see a chance for improvement. There are 56 furnaces, the smoke and flames from all of which go into two chimneys.

Absolute order, cleanliness and neatness prevail here, as in every other department of the establishment, and shower baths, with all needed accessories, are supplied for free use by the men who work here.

As castings are light and thin, usually ornamented by more or less carving, and are to be finished by oxydising or electro-

plating, the aim is to produce the best possible castings. Special care is taken with the mixture of these metals; a man being detailed for the work of weighing out and filling crucibles as they are needed, and he keeps his stock in a large safe provided for the purpose.

DOUBLE-FACE MOLDING.

What is known as the double-face method is followed here for all castings on which the best possible finish is desired. This is a process which, though it has been followed in some brass foundries for a long time, is not generally known among brassfounders. As explained by Mr. McTaggart, it is as follows: The mold is first made in the usual way, and then red sand is dusted on through a fine bag. Then a little fine charcoal is dusted on, after which the cope is put back and again rammed. The mold is then smoked with rosin and afterwards thoroughly dried.

Two views of the foundry are given, in one of which are seen the ovens in which the molds are placed to be smoked, and in the other the furnaces in which the molds are dried; the latter being heated by natural gas.

A KEY FOR LOCATING DIES.

In the punch-press department they have a very simple scheme, which they think a great deal of as a saver of time and bother, and this is shown in the sketch Fig. 3. The bolster has fitted to it the key *a* and all dies intended to be used in this bolster have a corresponding recess formed in one side so that they can go into the bolster only in one unvarying position, and as this position is the one in which they were laid out and in which they were when the punch was shaved, the operation of changing punches and dies is very much facilitated.

A SEPARATOR FOR SCREW MACHINE WORK.

Screw machine work and milling are, as usual, important departments, and in the former particularly, where John Dohner has charge, several unusual things were noticed, among them a simple attachment to an automatic screw machine, by which the pieces of work, as they are cut off, are separated from the chips and oil and deposited in a wire cloth pail. This is accomplished by a simple lever or two, suitably pivoted and moved by the cut-off slide in such a way that, as the cut-off tool is brought up to the work, a small cup, made of sheet metal and attached to the end of one of the aforesaid levers, is brought under the piece of work about to be cut off, and held there until the piece is separated and falls into it. The backward movement of the cut-off slide then moves this cup with the contained piece of work out of the way of other tools, to a point over the previously mentioned wire-cloth pail, where a tappet opens the spring-closed false bottom of the cup and allows the work to fall out. The whole rig probably cost less than $5 to construct, and anyone who has had experience with screw machines knows that the complete automatic separation of work from chips is worth more than that per month.

A STAMPING ROLL IN THE SCREW MACHINE.

Another screw-machine job somewhat out of the usual order, is the making of a knurled piece, 11-16 inch diameter, 9-32 inch long, a sketch of which, with a development of its surface, is shown in Fig. 4. It will be noticed that there are on this piece three groups of figures; three numerals in each group. These are sunk deeply into the piece (which is of brass, made from a drawn rod), and the operation is the same as knurling. In fact, the piece is first made as shown at the right of Fig. 4; the portion marked *a* being formed and knurled as shown, by a knurl held in the back post of the cut-off slide, and the knurl has formed upon it the three groups of figures required, which are thus made to rotate properly and keep in their proper places until the stop limits the further advance of this somewhat remarkable knurling tool. Afterwards the knurled projection *a* which has thus served as a driving gear for the figure roll, is cut off, and a forming tool takes a light finishing cut over the piece, removing all burrs thrown up by the formation of the figures and leaving the piece in every respect a creditable job; and of course much lower in cost than it would be if these figures were to be engraved, stamped or rolled by any of the usual processes as a separate operation.

Fig. 4. A JOB OF KNURLING.

A GOOD JOB FOR THE SCREW MACHINE.

The special fixture for another interesting job, is shown by the drawing Fig. 5. The piece to be made is called the "No. 79 Check Printer Cylinder," and consists of a cylindrical piece of brass about 1⅝ inches diameter by 1¼ inches long, in which two holes are bored longitudinally parallel but eccentric with each other. Neither of these holes are centered in the piece. The smaller one is ⅝ inch diameter and is $\frac{3}{64}$ inch out of center; the larger one is about ⅝ inch diameter and is slightly more than $\frac{3}{64}$ inch out of center in the opposite direction. Thus the holes cut into each other and the larger one cuts outside the piece, leaving an opening along its side about $\frac{1}{16}$ inch wide. Neither hole goes clear through the piece, but they are the same depth and square at the bottom.

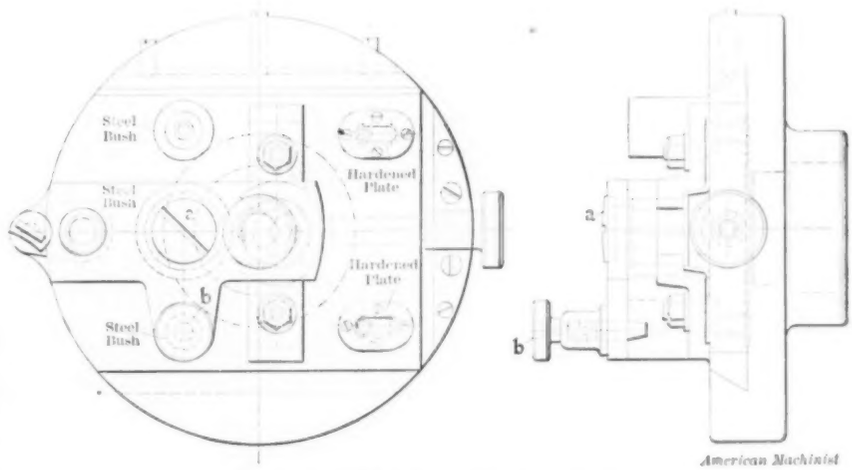

Fig. 5. A SCREW-MACHINE FIXTURE.

The fixture consists of a face-plate fitted to the spindle of a Warner & Swasey turret head machine. Across the face of the plate a dove-tail is planed, and to this is fitted the slide shown, which has a movement each side of the center sufficient to properly locate the piece for each hole, and the movement is limited by the pins and hardened plates shown by the drawing.

The tools which do the boring must, of course, pass through bushings, and these are fitted to the swinging plate shown, which turns upon the large screw *a* and is held in the proper position by the spring plunger pin *b*, the conical, hardened and ground end of which fits into either of the two hardened steel bushes shown, which thus properly locate the guide bushings. The job thus produced is not an easy one to make within the required limits of accuracy, but is accomplished by this fixture without difficulty and at reasonable cost.

Horizontal Drilling Machines.

BY JOHN RANDOL.

Examples of horizontal drillers now at work is various heavy shops in the United States clearly show that this type of tool can do a large range of work more cheaply and better than any other machine in use, and yet, so far as I know, only one firm of American tool makers lists a horizontal driller suitable for large work in its catalog, and in only one instance within my knowledge has a rangy horizontal driller been fitted for tapping with its main spindle. That a large horizontal driller should be capable of tapping a hole after drilling and before moving the work becomes evident upon very brief consideration.

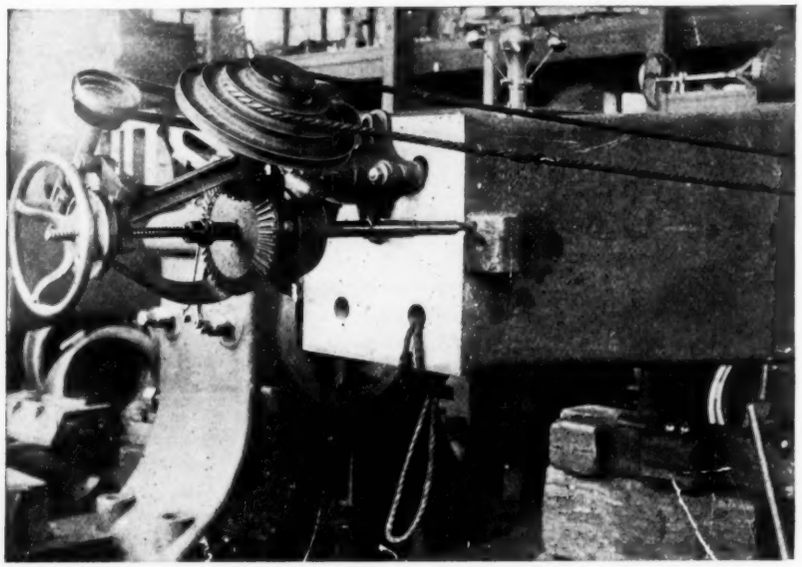

Fig. 1. PORTABLE DRILL AT WORK.

Having carefully observed the working of a horizontal driller and compared its production with that of other forms of drilling machine the investigator is led to inquire into the causes of the rarity of this tool, for it is by no means universally present in shops doing such a class of work as to make its use economical, and this rarity is even more surprising to one familiar with the early days of the machine shop, than to those younger engineers whose memory does not go back to the time when planers were a novelty. In some of the old machine shops all of the power drilling was done by horizontal spindles, the lathe doing all the drilling not done by hand. Drilling on the old wooden sheared lathes was very inconveniently performed; pieces of any considerable dimensions had to be blocked up and laboriously handled otherwise; the work was fed to the drill by the tail spindle, instead of feeding the drill to the work, and the vertical spindle wall-drill, the overhead suspended drill, and finally the prototypes of the modern pillar drill were held to be, and really were great advances over the lathe for driller's use.

With these early types of vertical drillers came two other vertical spindle tools with arch frames. One of these was a light horizontal revolving table with a sliding tool-carrying spindle overhead, all built very light for its dimensions, which has since developed into the chucking machine and the boring mill. The other had a horizontal vertically-adjustable main table fitted with a horizontally traversing dovetailed work-table, with an overhead vertical power-driven spindle, fitted to carry drills, boring bars, facing heads and boring tools, and provided with up and down hand and power feeds. This tool was also very light for its capacity, which was often about 72 inches between uprights, with about 36 inches horizontal adjustment of the work slide and 36 inches or 48 inches vertical adjustment of the work table. The early steam engine builders bored the shaft and crank-pin eyes of their long cranks on these vertical machines, which have now gone wholly out of use, and kept them busy on smaller work pretty constantly when there was no crank work in progress, and for the general shop, such as almost all machine shops were in those days, this form of driller and boring machine was an excellent tool, and it may perhaps be said to have developed into the radial drilling machine, which came in about the time the old "crank-borer" went out. The radial driller in its large sizes can drill much of the work which is so easily done on the type of horizontal spindle driller, of which this article treats, but it is not so convenient for the purpose, and costs vastly more, perhaps two or three times as much. The radial driller is also limited in the dimensions of its work, though the limit may be extended by the use of a pit, but the pit is in all cases an awkward expedient which, at best, only offers a choice of evils.

Horizontal drilling on the lathe was vexatious and inconvenient; the vertical spindle drillers of various types were accepted on sight as a vast improvement, and became the fashion so that a horizontal drilling spindle was looked upon as a relic of the "heel-tool" and "button-head" and hand-chaser practice, and went the way of other unfashionable things to obscurity without the lifting of a voice to defend it on the score of its real merits. Of late, too, our designers have produced a cheap and thoroughly good portable drill, so light that it can be readily taken to the work, and so conveniently arranged

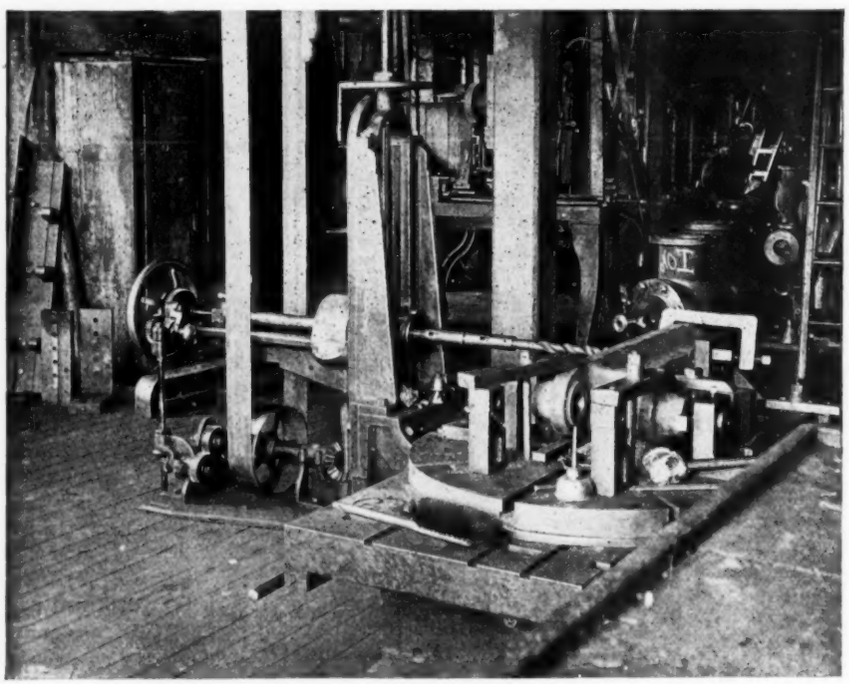

Fig. 2. AN ENGLISH HORIZONTAL DRILLING MACHINE.

that it can be very quickly placed in position, and this portable machine has perhaps done more to prevent the use of an improved form of horizontal drilling machine than any other one thing.

Fig. 1 is from the Providence Steam Engine Works, showing such a portable drill at work on holes which could not be reached by the radial driller, though one of the largest of them is in the shop.

Fig. 2 is also from the Providence Steam Engine Works, and shows an extremely useful and convenient type of the small horizontal driller. This tool has been in the shop so long that its history has been lost. It is supposed to be of English origin. The horizontal spindle has about 30 to 36-inch vertical adjustment in the upright. This horizontal drill-spindle is served by a long table fitted to slide on the bed of the machine, which is T-shaped. This sliding table carries on top a rotary work-table with radial T-grooves. The whole machine is so simple as to be readily comprehended from the engraving, and it never stands

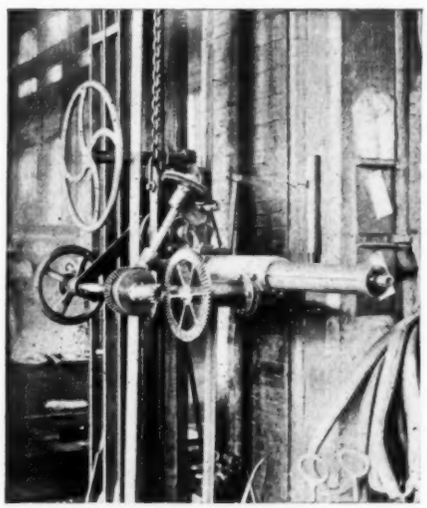

Fig. 3. THE ALLIS DRILLER.

idle. So far as my observation goes, this horizontal driller is unique, but illustration here will doubtless disclose its origin.

Fig. 3 shows the spindle carriage of a horizontal spindle driller from the Allis shops, Milwaukee, Wis. The surroundings were such as to make it impossible to obtain a picture showing the entire machine. This driller is served by a heavy traveling work-table, or carriage. The spindle saddle is hand-adjusted, vertically by means of a rack and pinion in ways in the vertical cast iron column which supports it, and is counterbalanced. The spindle is carried in a rack-driven quill, and has a worm-gear feed and a quick hand-adjustment horizontally.

Fig. 4 is from the De La Vergne shops and shows a driller of which several were built by the old Delamater shops, New York. The castings for the first of these Delamater drills came from the original Corliss shops, Providence, R. I. This driller proved so satisfactory at the Delamater shops that other shops became purchasers of them, one going to the Fletcher shops, Hoboken, one to the De La Vergne and others, as I am informed, to other places. These Corliss drillers as built by the Delamater shops were not arranged for tapping, however. The one now in the De La Vergne shops had its spindle fitted with a reverse motion by Mr. Aui, superintendent, at a very small cost, and is, as it now stands, an extremely convenient tool for drilling work of every description, and is kept constantly busy, although the De La Vergne shops are supplied with a very full equipment of portables and electric drives for the same, as well as small iron drilling benches having planed and T-grooved tops on which both the portable driller and work to be drilled by it can be quickly bolted.

Knowing that Mr. Edwin Reynolds, now for many years connected with the

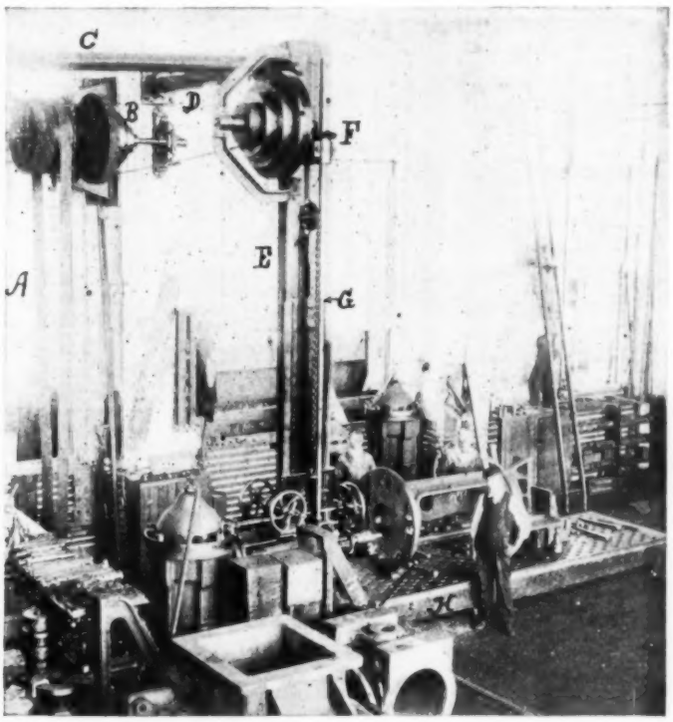

Fig. 4. THE CORLISS HORIZONTAL DRILLER.

Allis shops, Milwaukee, was at the Corliss establishment when the Delamater works obtained the first set of driller castings from Corliss, and thinking it probable that this driller and the Allis driller shown in Fig. 3 were both designed by Mr. Reynolds, I wrote him a letter of inquiry to which he replied as follows:

"Answering yours of 27th, I beg to say I did not design the drill you refer to, but always understood it was designed by Mr. Corliss. I know nothing of its previous history, if it had one. I well remember the set of castings sold to the Delamater works, as I was in the employ of the Corliss Company at the time.

"I did design the drill in use at the Allis works, which differs from the Corliss design in that the drill spindle passed through a slot in center of column instead of being hung on one side, as in the Corliss plan, which tends to twist the post. The spindle of the Allis drill is driven with a belt from a pulley at the top (in place of vertical shaft and two pairs bevel gears as in the Corliss). The belt passing between and partially around three pulleys on the spindle and carriage carrying the spindle and down around an idler pulley at the bottom, permitting the free rise and fall of spindle without changing belt contact with pulleys. Later I designed a similar drill carrying the drill spindle and saddle on two round columns, also including a vertical spindle carried on same columns arranged so that vertical holes could be drilled without turning the work."

The drive of the Allis drill, Fig. 3, is very neat, and the disposition of material in the pillar is excellent. The position of machinery on the floor is such as to make a photograph of the entire machine impossible. The changes of speed are easily and quickly made, which is not the case with the Corliss-Delamater driller. The drive of this machine is from an electric motor standing on the floor, and delivering power through the vertical belt *A* to the countershaft *B*, whence power is taken forward to the machine cone by a horizontal belt. The countershaft and machine cones are 4-strapped, with diameters, I should say, of about 10 and 26 inches, for the extremes, making it very difficult to shift the belt, especially at such a hight above the floor. The pillar *E* is light, stands on a small base, and requires the braces *C* and *D*, leading from its top

to the wall to make the pillar secure. From the machine cone shaft power is transferred through the bevel gearing *F* to the vertical splined shaft *G*, which rises and falls with the spindle saddle through about 120 inches of vertical adjustment, thus requiring at least 10 feet of head room more than is needed by the Allis driller for the same vertical range. The countershaft and braces are secured to the wall of the shop, which is highly objectionable.

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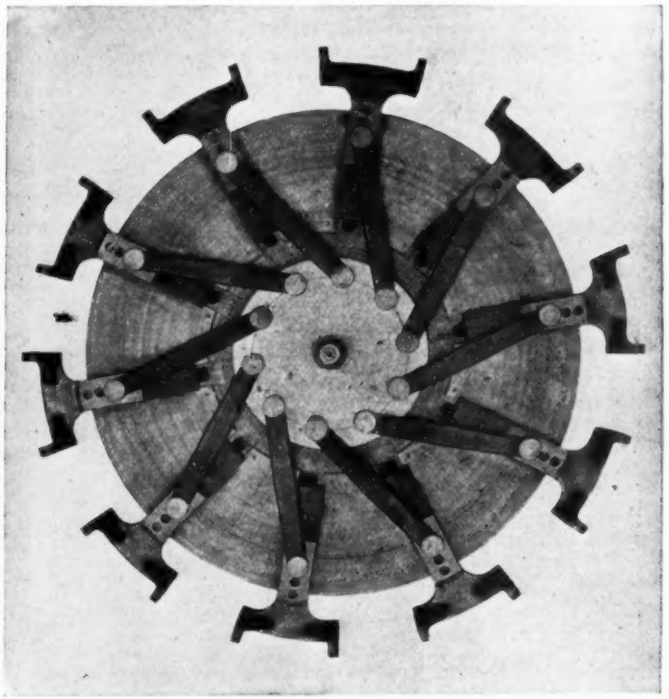
Wheel-Assembling Machine.

We illustrate herewith a wheel-assembling machine the construction of which will be readily understood from the engravings. It is designed to use as many jaws as the number of spokes in the wheel will permit in order to true the wheel at every possible point, and as shown, these jaws are moved by connections to a central disk, so that the rotation of this disk moves them in or out. A hub extends from this disk beneath the plate, and it is moved by means of worm gearing actuated by the crank shown at the side. The plate rests on ball bearings, giving it a free motion, and it is found easy for the operator to assemble the entire wheel without moving from his position, or, if desired, two men can work at the same machine.

WHEEL-ASSEMBLING MACHINE.



WHEEL-ASSEMBLING CHUCK.

The engraving shows the machine with a heavy wheel on it, and with the hub bolted to an upright arbor sufficiently heavy to hold it firmly, but for lighter wheels a supporting frame-work or tripod is fastened over the hub to prevent any spring. It is found in practice that many wheels assembled on this machine require scarcely any subsequent truing, even though the rims were originally warped out of true considerably. It is manufactured by the L. E. Rhodes Company, Hartford, Conn.

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The Steam Diagram of the Air-Brake Pump.

The following letter, recently received, will explain itself:

"Enclosed you will find a sketch of an indicator card from the steam end of an air-brake pump, Fig. 1.

"I have taken the stand that the efficiency of the pump will be found by dividing the horse-power output of the air cylinder by the horse-power input of the steam cylinder, as shown by the perfect parallelogram bounded by the dotted line in the sketch, Fig. 1, and not by dividing the output of the air cylinder by the horse-power of the steam cylinder, as shown by the indicator, as, unlike the case of an ordinary engine card, the indicator does not show the entire input into the steam cylinder.

"In this case the indicator does show the effective horse-power, the difference between this effective horse-power and the total input of the steam cylinder being lost work, so far as results in the air cylinder are concerned, and so necessarily reducing the efficiency, this lost work being due to the choked exhaust in the lower shaded part of the diagram and to wire drawing in the upper shaded portion.

"To put it in another way, as every cylinder full of air requires a cylinder full of steam at initial pressure, the true efficiency would be found by dividing the horse-power output of the air cylinder by the disposable horse-power of the cylinder full of steam. If I am in error in this matter, will you kindly set me right?"

The best way to answer the above is to talk around it, not at all for the purpose of evasion, as is so common a custom, but so that we can see a little better the different sides of it and get a better understanding of the matter.

The indicator diagram from the steam cylinder of the air-brake pump is one of the most interesting things of a technical nature within our knowledge. Many even of our readers are probably unfamiliar with the peculiar form of this diagram and few have penetrated the true inwardness of it. Our correspondent is, of course, all right in his position, but we might perhaps differ somewhat from him in the mode of stating our views. He evidently does not mean exactly what he says in the statement that "unlike the case of an ordinary engine card, the indicator" (in the brake-pump card) "does not show the entire input into the steam cylinder." It of course does tell indisputably the volume of steam admitted into the cylinder, but it does not tell it in precisely the same way as in the regular engine card. The entire parallelogram, of course, shows the steam consumption, and this is as clearly deducible from the diagram as the steam used in a Corliss engine is proved by its diagram.

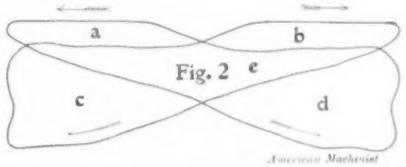
As to what data are to be used in computing "efficiency," will depend upon what efficiency is allowed to mean in the given case. If with a common steam engine diagram we take the mean effective pressure, as shown by the enclosed area of the card, and, in connection with the

dimensions and speed of the engine, compute the power developed, and compare that with the work that is actually done, there is no apparent reason why we should not treat the brake pump diagram in the same way.

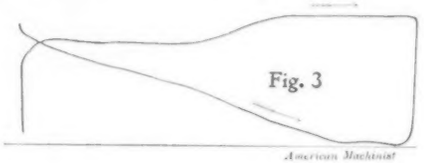
Of course, when it comes to actual efficiency, steam is money, and when we want

to know what the power costs, or what anything costs that is done by the power developed, we must in every case go back to the steam used. We should, indeed, go farther. Whether it is an air-brake pump or a quadruple expansion marine engine, the coal pile is the ultimate test, but the indicator diagram does not reach so far.

As with our general indicator practice,



it is so often impossible to go back to the coal pile, while it is so easy to get near to the steam consumption, it would be well if there were established and generally understood some standard of steam value based upon the easy possibilities of steam power under the best conditions, and to which all engine performances could be referred, and then the low percentages so generally realized might serve as reminders, might stand before us to reproach us, or urge us to better practice. The stand-



ard here referred to would be a standard of steam value, and not at all a standard of steam cost, which is another matter, and one perhaps kept more prominently in view.

The indicator diagram in Fig. 1 may serve to call attention to some very loose practices in indicator work in general. The indicator, of course, tells us many things very clearly, things that it is very important to know, but it is also allowed to mislead us in some other respects. We are quite apt, although we know better, to look upon the diagram as representing the single stroke instead of the revolution, or, in the case of the air-brake pump, the single stroke instead of the double stroke. The practice does not mislead us in our computations upon the power developed, but we are very apt to be misled as to the distribution of the power throughout the stroke.

Take, for instance, the card before us, Fig. 1. Regarding only the enclosed area of the card, and measuring the vertical depth of it at different points, it looks as if there was more effective force exerted upon the piston in the earlier part of the stroke than later. Let us see about that. As we have but the single card we have to assume that the diagram is the same for each side of the piston, or, as we generally say, for each end of the cylinder. We reverse the diagram and trace it upon the other and we then have Fig. 2, showing

the complete cycle of steam action upon each side of the piston. We indicate by the several arrows the direction of the piston motion when each line was traced. It is evident that the lines whose arrows point in the same direction belong to the same stroke. We select the steam and exhaust lines whose arrows point to the right, the same as the arrow in Fig. 1. We trace those lines, and we have in them,

Fig. 3, the true story of the pressure upon each side of the piston for one stroke of the pump.

It does not look here, by any means, as if the piston had a greater effective pressure upon it at the beginning of the stroke. It will be noticed instead that the back pressure is greater than the steam pressure, and it would seem to be impossible that the piston could start at all. Fig. 5, which is a card from the air cylinder of the air-brake pump, shows that there is quite a body of air cushioned in the end of the air cylinder and the re-expansion of this air gives the piston its start and carries it along until the steam pressure exceeds the back pressure in the steam cylinder.

Although Fig. 3 is so different in shape from Fig. 1 it is demonstrable, without the trouble of measuring it, that the area is the same, that therefore the mean effective pressure represented is the same and consequently the power computed from it will be the same. As the diagrams in Fig. 2 for the two ends of the cylinder are similar, and as the double diagram is symmetrical, *a* is equal to *b* and *c* is equal to *d*. Fig. 1 is composed of *c*, *e* and *b* and Fig. 2 is composed of *d e* and *b* and as *c* and *d* are equal Fig. 3 is equal to Fig. 1.

Fig. 3 becomes Fig. 4 by simply straightening the lower line and retaining the same vertical distances at all points, and Fig. 4 shows actually the best known steam card for doing directly the work to be done as represented in the air cylinder card, Fig. 5. It is a wonderful achievement of ingenuity that the usual steam cylinder diagram can be so transformed for a special purpose, and can be made so satisfactory for that purpose as to annihilate the objection that as compared with the actual power developed it is the most wasteful application of steam known in modern engineering.

▲ ▲ ▲

Engines of the "Pennsylvania."

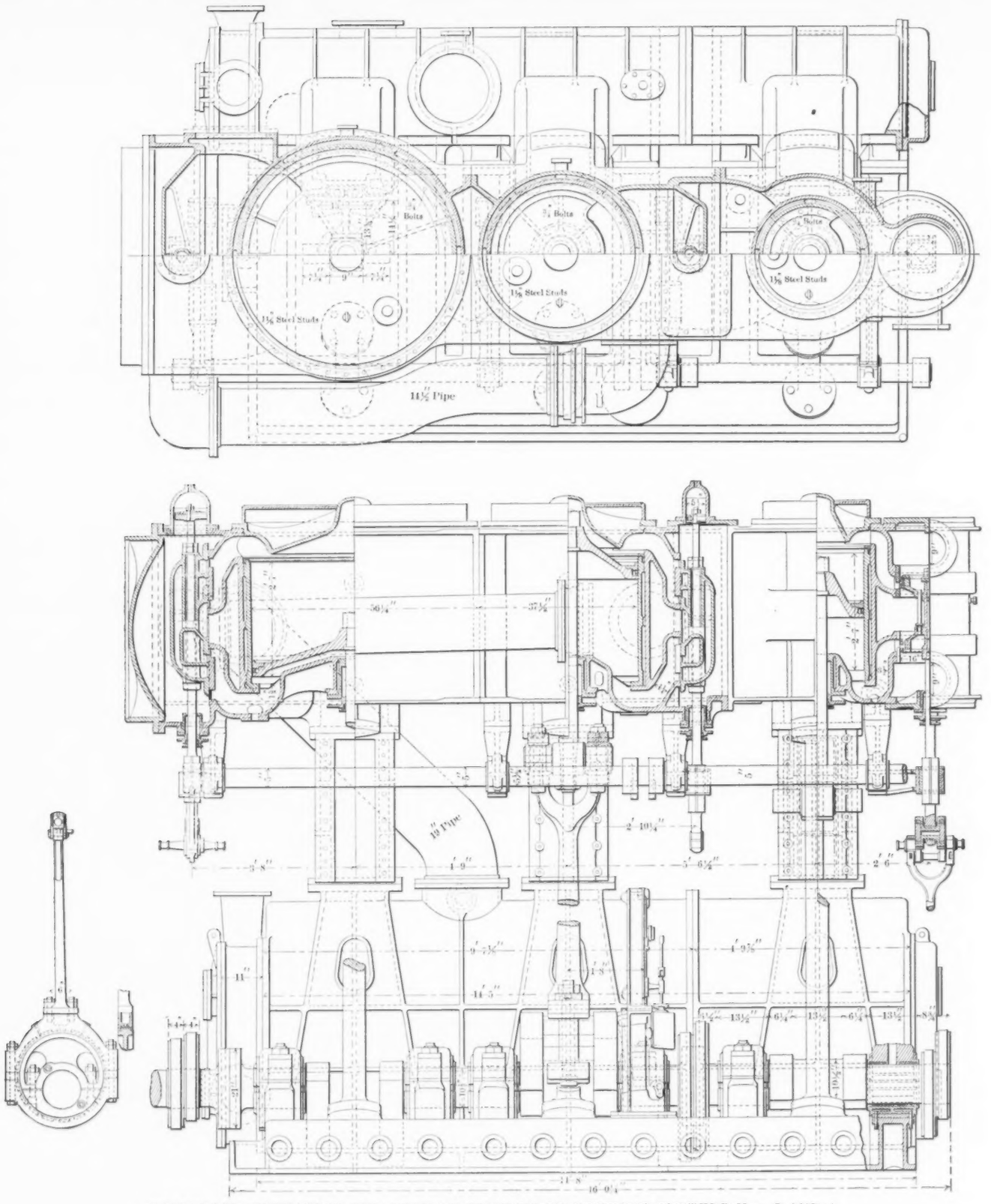
A few particulars concerning the engines of the mammoth freight steamer "Pennsylvania" will be of interest to our readers. The shafts for the twin screws are 227 feet long over all, the tunnel shafts being 13¾ inches diameter, and the propeller shafts 14½ inches diameter; all the shafts being hollow. The horizontal distance between the centers of the shafts is 17 feet 6 inches forward, and at the propellers 13 feet. The engines are quadruple expansion, the cylinders being successively 23, 33, 48 and 69 inches diameter by 54 inches stroke, the normal speed being only 75 revolutions per minute. The arrangement of the cylinders fore and aft is, H. P., L. P., 2d Int., 1st Int. The balanced cranks are not at equal angles all around. In the go-ahead direction around the shaft the sequence is as follows: H. P., 100°; L. P., 100°; 2d Int., 100°; 1st Int., 60° H. P. The screws are three-bladed, 16 feet diameter and 21 feet pitch. The port propeller is 5 feet forward of starboard propeller, so that they will clear each other. There are three double-ended Scotch boilers and two single-ended, with 24 furnaces, 433 square feet of grate area and 15,025 square feet of heating surface. The top of the funnel, 12 feet diameter, is 98 feet above the grate bars.

▲ ▲ ▲

Engineering Qualities.

"With regard to examples of courage, one can recall among many others such instances as the behavior of the engineering staff in the sad foundering of the great line-of-battle ship 'Victoria,' some few years ago; the continual exhibitions of heroism and self-devotion in mining, whether under ordinary conditions or in accidents and explosions, in sinking or driving under compressed air in such instances as the Hudson Tunnel; in the study of explosives and of gases; and in the endless contests which engineers undertake with the forces of nature.

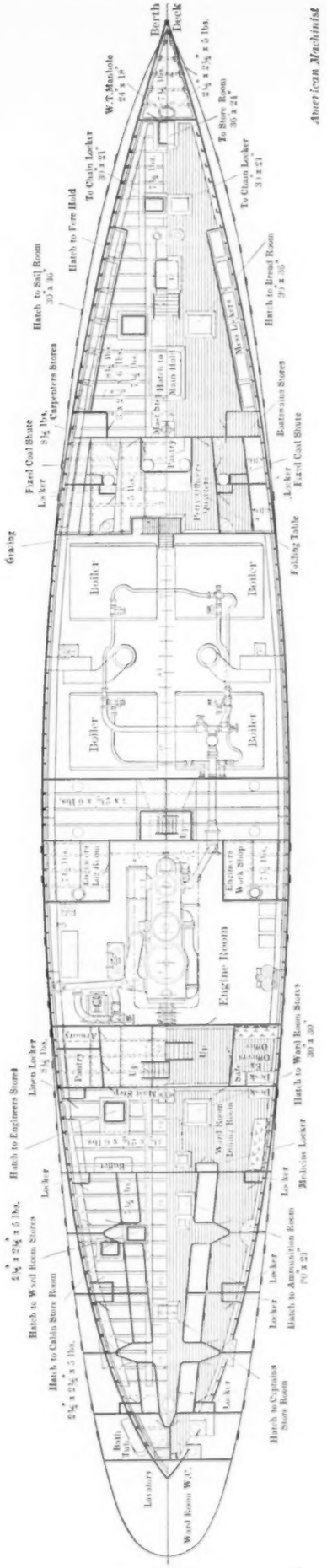
"Of constancy or fortitude under difficulties and discouragements, we can recall many pathetic instances in the records of our profession, and we read of them continually in such works as that of the 'Lives of Engineers,' by Smiles. Brindley in his canal work, George Stephenson in his early endeavors with the locomo-



STARBOARD ELEVATION AND PLAN OF ENGINES OF REVENUE CUTTERS Nos. 3 AND 4.

tive, the elder Brunel at the Thames Tunnel, Bessemer in his struggle for many years in the perfection of his new process of steel manufacture, and in the long, wearisome, and frequently unsuccessful lives of engineering discoverers and patentees. These are merely conspicuous instances of what we all know to be the case, that an engineer in his career must expect trials and disappointments, and requires constancy, fortitude, and calmness under difficulties if he is to triumph in the battle of life.

"Loyalty again to his employers, to his engineering brethren, to his subordinates, and to contractors and others, is a necessary quality of a leader, and conversely of the juniors of the profession towards their chiefs. They are trusted with his confidence, and if they possess this loyalty they will not abuse it. They are relied on to do their best whether the eye of their master is on them or not, and if they are worth anything, they will give their services ungrudgingly and without stint, in the same way as a good soldier does not consider the why or wherefore, but takes



BERTH DECK.

the widest view of his duty. Such loyalty between all classes of our profession is a most important quality, and I think I may boast of us all, and say that in no calling is there more of what I may call comradeship, and less of mean jealousy, than in ours.

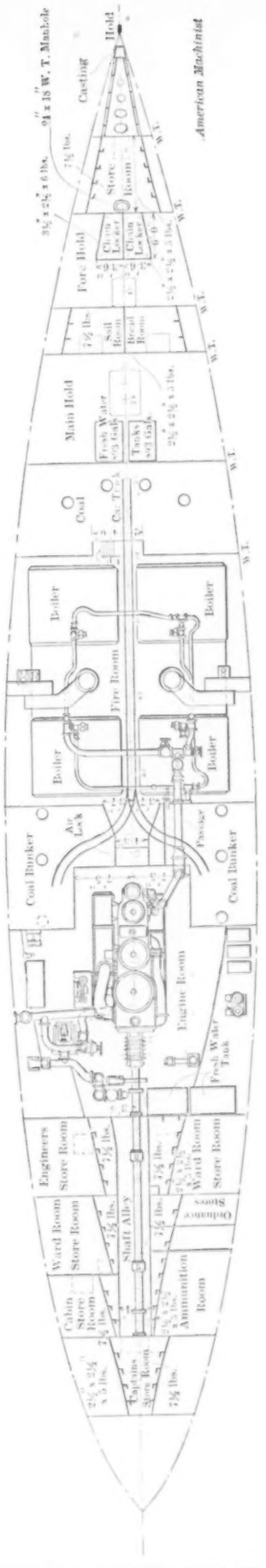
"Uprightness is the fourth of the qualities which I named as essential. The amount of confidence given to engineers is perhaps greater than in other walks of life. At any rate it is very great, whether one considers the money we expend, or the lives dependent upon our work and direction. The capital of our railways is now some £1,000,000,000, or 33 per cent. more than our national debt, and I suppose that other engineering undertakings, such as harbors, docks, tramways, sanitary undertakings, mining enterprises, electrical developments, and other enterprises, would represent as much more. These vast sums have, practically speaking, been spent during the last fifty years, or at the rate of £40,000,000 per annum. For the annual upkeep of these works I should imagine engineers annually control funds very much more than the whole taxation of the country, and I rejoice to say that I cannot recall to my mind any example of malversation of funds by a British engineer. Where such confidence is given, the most scrupulous uprightness is demanded, and must be one of the conspicuous qualities of an engineer's equipment. It is, of course, the attribute of any honorable man in every path of life, but I think few professions have the control over such large sums as we habitually have."—Sir J. Wolfe Barry, C. B., F. R. S.

▲ ▲ ▲

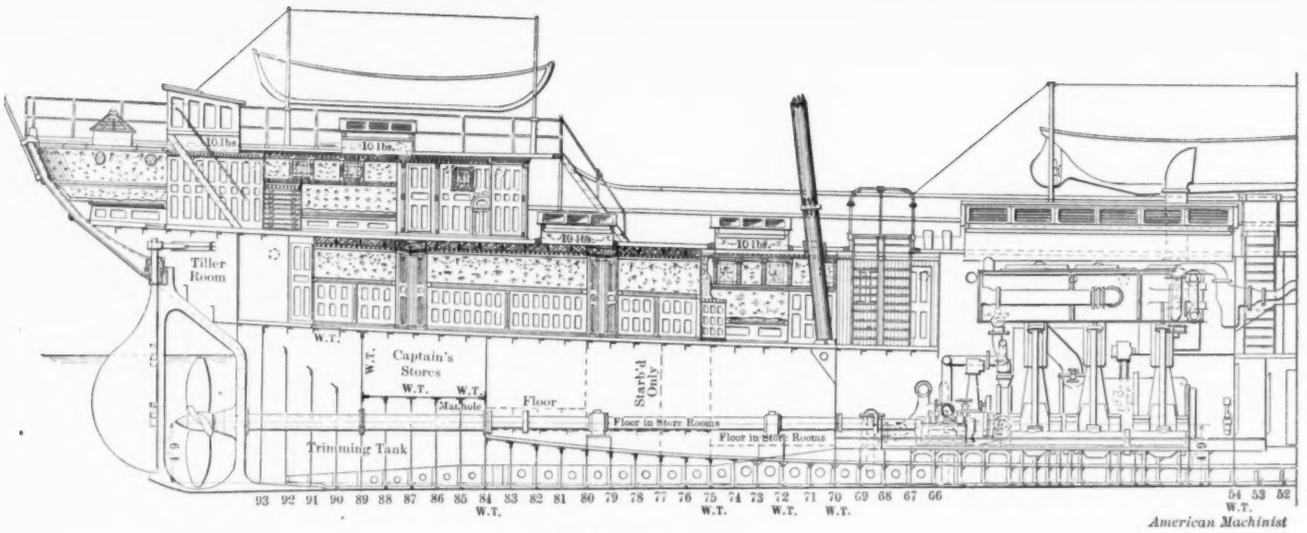
Machinery of U. S. Revenue Cutters Nos. 4 and 5 for the Great Lakes.

By the kindness of Capt. John W. Collins, Engineer-in-Chief of the United States Revenue Cutter Service, we are enabled to lay before our readers some illustrations relating to revenue cutters Nos. 4 and 5, designed for service on the Great Lakes. In our issue of May 7, 1896, we illustrated quite fully the engines and boilers of revenue cutter No. 3, for service on the Pacific Coast. The present vessels are so nearly like the preceding that the illustrations now given may be taken as additional or supplementary to those previously presented.

Nos. 4 and 5 are somewhat smaller in each of their principal dimensions than No. 3; the draft is four feet less, and the displacement only a little over two-thirds as great, and with engines and boilers practically identical, although developing 20 per cent. more power, on account of increased speed of revolution and other working conditions, the vessels should show excellent speed. The guaranteed speed is 17 knots; the "Gresham," another vessel of almost identical design, developed 21.09 miles per hour on her trial trip last December.



HOLD OF REVENUE CUTTER.


10 lbs.
Tiller Room
W.T.
Captain's Stores
Manhole
Floor
Starb'd Only
Floor in Store Rooms
Trimming Tank
93 92 91 90 89 88 87 86 85 84 83 82 81 80 79 78 77 76 75 74 73 72 71 70 69 68 67 66
54 53 52
American Machinist

INBOARD PROFILE.

The principal dimensions of the vessels are as follows: Length over all, 205 feet 6 inches; between perpendiculars, 188 feet; breadth of beam molded, 32 feet; depth of hold, 17 feet; draft, 10 feet 2¼ inches; displacement, 850 tons.

The dimensions of the engines are: Cylinders, 25, 37½ and 56¼ inches diameter by 30 inches stroke, and the collective indicated horse-power at maximum speed will be about 2,400. In this is included the power used by the air-pump and circulating pump. The propeller is to be of manganese bronze, right-handed, and 10 feet in diameter.

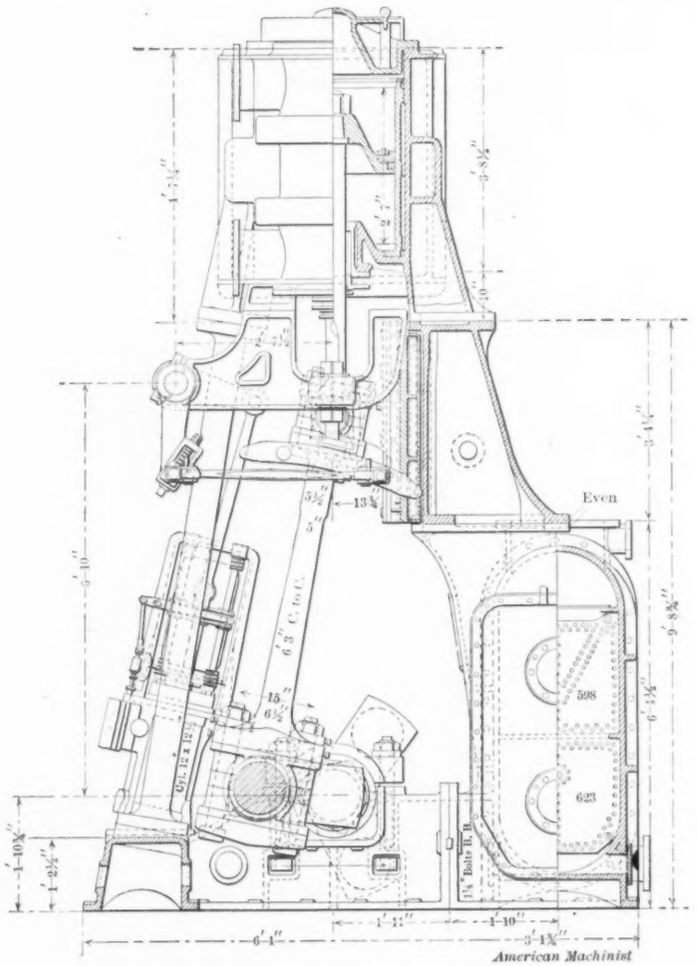
There will be four single-ended steel boilers of the horizontal return fire-tube type, working up to a pressure of 160 pounds. They will stand in a separate watertight compartment with a common fire room between them. Each boiler will have two corrugated steel furnaces 3 feet 6 inches internal diameter. The total heating surface will be about 5,250 square feet, measuring the tubes on the outside, and the grate surface 168 square feet. The boilers will be 11 feet 8 inches outside diameter and 10 feet long over all.

The inboard profile and the hold and berth deck plans give a good idea of the general arrangement. There is the usual modern complement of pumps and auxiliary engines for various service.

▲ ▲ ▲

A Patent Belt Shifter—Money Thrown Away on Patents.

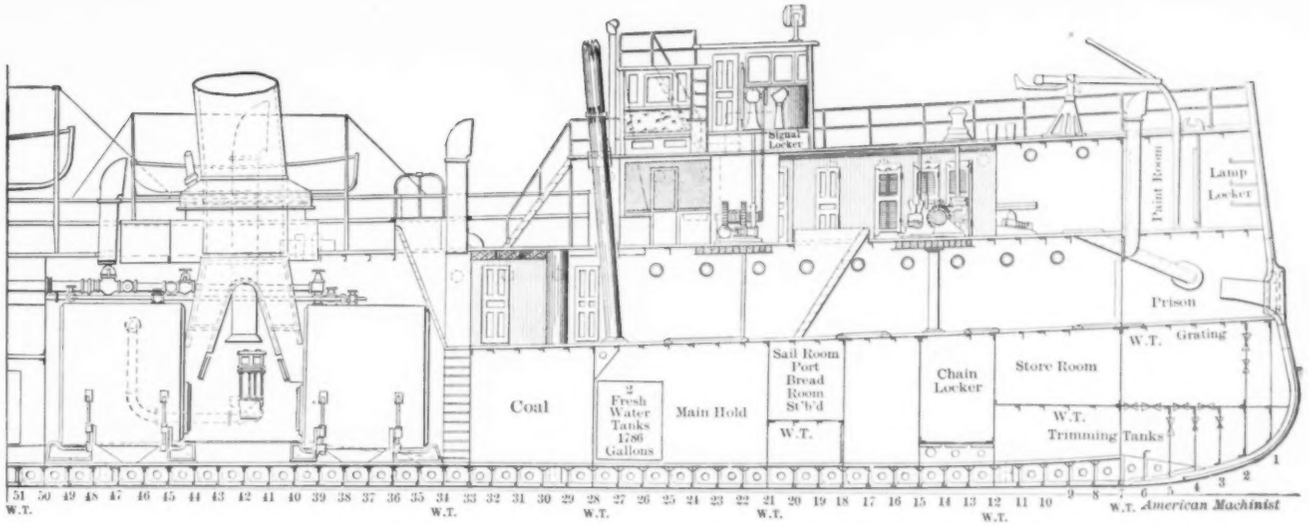
The cut herewith shows the essential features pertaining to a recent United States patent. The letters of reference are omitted as unnecessary. It is, as every reader will see, a belt shifter, and the invention consists in having the shipper prong made of round iron with screw thread and nut on the end, and then stringing the rod full of round disks of leather, vulcanized fibre or similar material. The disks are to be held loosely, so that they will be free to turn when the edge of the belt comes in contact with them, and the invention is therefore incomplete, as there should have been a metallic washer under the nut, and there should also be a jam nut.



FORWARD ELEVATION AND PARTIAL SECTION.

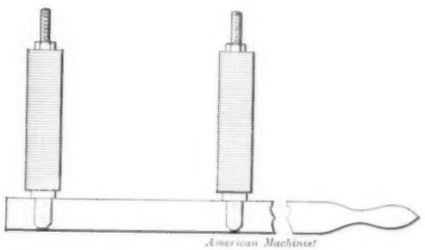
It is difficult to believe that there is the slightest novelty in the invention, although a patent office examiner very likely could find nothing on record to conflict with it, as no one would have thought it worth putting on record. The patent, by the way, was more than two years and a half in getting through the office, so that there must have been some conflict over it. We have often known a loose piece of gas pipe used on a shipper prong, and it does not look as if the present arrangement was as good, while certainly much more expensive and troublesome.

This invention is patented in Great



INBOARD PROFILE.

Britain and the United States. We cannot help wondering a little as to what process of reasoning induced the inventor to incur the trouble and expense of obtaining the patent. That there is any invention in it at all is questionable, that the invention is in any way valuable is problematical,



A PATENT BELT SHIFTER.

and that any profit can ever be realized from it is chimerical.

The fact is that if everything about this invention was all that the inventor's fancy painted it, there would still be scarcely a possibility of holding it. The inventor, of course, needs publicity for his invention, or certainly he could have no customers, so in setting it before the public as we do, we are working in his interest, but, unfortunately, anyone who sees it and wants it, will be very likely to go on and use it without entering into negotiations with a resident of Plymouth, England, and the Englishman would have to hunt up his device in every shop throughout the country. He would have at least the consolation of knowing that a native American patentee would not fare a bit better.

It is all right to keep continually thinking of "simple things to patent," as the patent agents so industriously urge, but it is very necessary also to do much more thinking all the while about how to so handle the things as to realize some profit, and if there is no visible possibility of such profit, to go very slow about the patent.

Letters from Practical Men.

The Mathematician vs. Constructor as a Student.

Editor American Machinist:

I was much interested in the letter in your issue of March 18th, written by Professor Hutton, on the "Mathematician vs. the Constructor as a Student." He points out clearly two dangers that beset our engineering schools: first, the danger of conferring the degrees on mathematicians who are not and never can be engineers in the true sense of that term, and second, the shutting out from the profession some, who by reason of their talents in some special field of engineering, would rise to distinction. These dangers are real I believe; and one thought occurs to me that may possibly throw some light on the cause of this trouble, and thus be one step toward its cure.

There are men with minds that are wonderfully active and alert on abstract questions, but who never succeed in grasping enough of the concrete facts of this life to be of great service to their fellow-men. Their reasoning may be accurate and logical enough, but they fail to see things about them as they are, and therefore leave out some of the vital conditions in the start. These are the men that stand in the front rank on leaving college and are not apt to be heard from again. They make easy work of their mathematics and pure science, but do not show the same proficiency in the drawing-room, shop and laboratory. For them this latter class of work should be emphasized, and all their work made as practical as possible.

On the other hand, there are men who grasp concrete facts with great facility, but find equal difficulty with abstract ideas. These men are therefore likely to find mathematics, and perhaps pure science to some extent, a stumbling block in the path to success.

I cannot believe it wise even in this case, were there no others to be considered, to remove this stumbling block or even to lower it, and thereby remove or impair so valuable a tool to every engineer as mathematics, and decrease the training in exact, logical thinking and accurate analysis. These are the very men who need this training most.

My remedy for one case is the same as for the other. Instead of removing or lowering the stumbling block from the concrete to the abstract for the men of practical mind, I would try to build an inclined plane reaching up to it, that they may surmount this and even greater obstacles without falling. The nature of this inclined plane would be a continuous series of practical problems, the more practical and familiar the better, in all subjects of an abstract nature, but especially in mathematics and mechanics; emphasizing these problems as much or more, than any other portion of the work. The same idea would require that in the shopwork, the drawing and designing, and the chemical, physical and mechanical laboratories, the theoretical aspect of the questions be kept continually before the minds of the students, and thus the path be made continuous from the most concrete, in shopwork, to the most abstract, in pure mathematics. This method would be of as much value to the students who easily handle the pure mathematics, but find difficulty with the practical side of their work, and would serve as the inclined plane to bring them from abstract questions to concrete facts.

In conclusion I cannot refrain from expressing my belief that if this idea were more universally carried out in our technical schools, if their courses were thus closely related so as to be in reality one course from entrance to graduation, with equal emphasis placed on all parts of the work, we should see less of the prejudice against the technical graduate and his

training, and the old song of "Theory and Practice do not Agree," would die away in the distance.

ARTHUR L. WILLISTON,
Ohio State University.

[Is not the argument for mathematical studies as a means of discipline, closely parallel to the argument by which the old school of educators endeavored to rivet the study of Greek and Latin on all students? It certainly has a familiar sound. We have all heard the disciplinary value of those studies (which, as a matter of fact, none will deny) insisted upon, as well as the companion argument that the less aptitude a student had for them the more he needed their discipline and the more good they would do him. The position has had to be abandoned in the so-called liberal courses of study, and we believe it to be equally untenable in technical education. Moreover, the study of mechanism involves just as good and severe mental discipline as does mathematics; in fact, we could name a strictly practical and standard book on mechanism, purely graphical in its treatment and absolutely devoid of mathematics, which was taken up near the end of a course and voted by the entire class to be the most difficult subject they had encountered.

We believe the purpose of a course of study in engineering, to be the making of engineers and citizens, and that the only gage by which a study can be measured is its value for that purpose. Mathematics is of value to an engineer as a tool and nothing else, and the kind and extent of mathematical studies in an engineering course should be governed by that consideration. A student's course at college is too short to permit any of it to be spent on studies having a disciplinary value only, and the time, if there be any, which can be spared from strictly technical work, should in our opinion, be devoted to such subjects as history and economics, which are of more importance to every man in his capacity as a citizen than any amount of mathematics pursued as a means of discipline for the mind.—Ed.]

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Pattern for Hydraulic Jack Head.

Editor American Machinist:

Recently I had to make a pattern for the head of an ordinary hydraulic lifting jack, and, as it is open only at one end, and it is necessary that it should hold water or whiskey under pressure, it was advisable to be able to secure the core without anchors. The annexed drawing shows how the pattern was made to meet the desired end.

Fig. 1 gives three views of the casting, as received from the foundry.

Fig. 2 shows the pattern, *a* and *b* being loose, so that it could be molded on end, and the core print only comes in the cope, enlarged, as shown, beyond the diameter of the casting, thereby securing ample seat for the core on the parting face of the nowel. It can be seen that when the cope is in place and properly clamped, the core cannot rise when the metal is poured.

Fig. 3 shows one-half of the core box. If we had not required the corner of end rounded, there would have been no need to have any part of the box loose. The loose piece marked *a* conforms to the outside of the pattern; consequently, the inside edges are very thin, so I made that

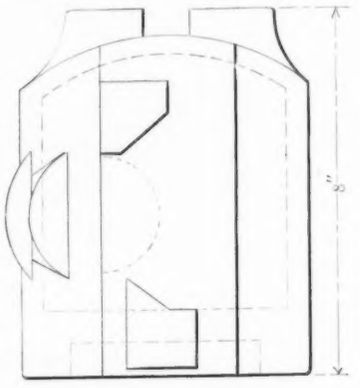

Fig. 1

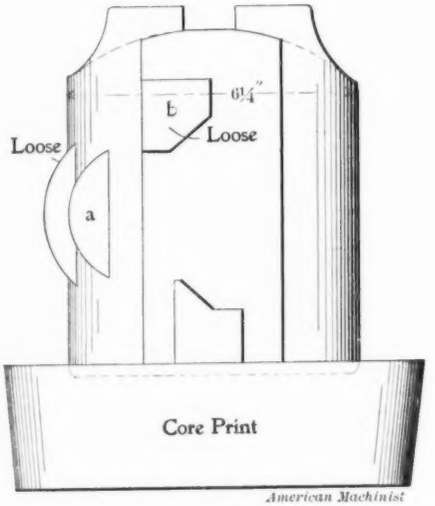

Fig. 2

PATTERN FOR HYDRAULIC JACK HEAD.

part in plaster of paris, and suppose the molder made one in metal, as it is likely that quite a few will be needed for repairs.

WILLIAM NEWTON.

Oneonta, N. Y.

▲ ▲ ▲

Holding the Lathe Tool.

Editor American Machinist:

The letter of Mr. Austin in the "American Machinist," March 25th, criticising various faults, and some things which we would scarcely call faults, in American tools with which he is familiar in England, will be received, I doubt not, by American readers with hearty appreciation and welcome. There can be no mistaking the spirit of it. The friendly and helpfully suggestive motive is self-evident, and the freedom and sincerity of expression invite in return unrestricted discussion. I do not know of any better way to express my esteem than by treating the writer as one of ourselves, and talking back where I have anything to say.

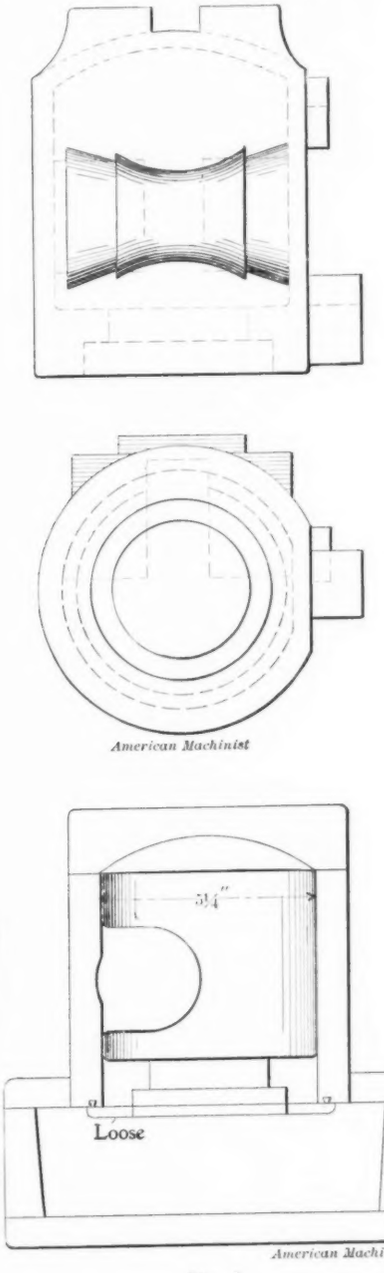

Fig. 3

Of the many points touched upon in Mr. Austin's letter, I wish to allude here to a single one, without the slightest reference to any other. It happens, however, to be the one in which I think it will be developed that American, let us say prejudice, is arrayed most strongly against him, and least likely to yield or to be persuaded. Mr. Austin says: "Lathes over

16-inch swing should have four bolts and two plates in place of the usual American tool post, which, in our opinion, is only suitable for light lathes."

Now, what in the world is the use of four nuts to tighten, when one screw will hold the tool securely? I have run lathes with American tool posts a good many years, and the slipping of the tool was about the least of all the troubles that I ever experienced.

As a foreman I did have a rather sickening experience with a two-strap, four-stud tool holder on a lathe. It was on a pulley-turning lathe, swinging about three feet, and the latheman, by the way, was an Englishman. He could never get a wrench long enough for those nuts, and he was stripping them or breaking off the studs or pulling them out continually, and the cost of keeping up nuts, studs and wrenches for that lathe was probably as great as that of all the repairs for any half-dozen other lathes in the shop. The man used to rush out a lot of work, and I had unlimited patience with him. I knew all the while that he was not more than half to blame. The mode of fastening the tool as provided for that lathe gave him a wrong impression. It told him a lie, and he swallowed it and had to live up to it. The design said plainly enough that it took an enormous pinch to hold the tool, and he looked out for it that the tool did get all the squeeze that the facilities provided enabled him to give it. It made no difference to him that a 5-foot lathe along side of him had a single screw tool post, or that every other lathe in the shop had a single tool post, the tools on his lathe were going to be held as tight as possible.

Now, while I don't propose to accept the two-strap tool holder as preferable to the tool post, for lathes up to, say, 30-inch swing, and probably considerably larger, I am still far from being satisfied with the tool post. There is probably nothing about the lathe that is less satisfactory. It is not that you cannot hold the tool securely, but that you cannot hold it in precisely the best position. The tool post, with the big collar on which the tool rests, prevents it from getting close up to the work on the side. The trouble is not got rid of, but considerably aggravated, by the two-strap idea. The holding device for the tool should be really all on one side of it, so that the side of the tool shank could, when necessary, as it often is, come close up to the work. The holder should then be reversible, so that the tool body could clear on whichever side it might be necessary. This of itself would often enable the tool to be held shorter, and render it less liable to slip or spring or chatter.

Then there should be a readier and better means than we have of pitching the tool either sidewise or lengthwise. This while not necessary and generally injurious on the planer, is quite desirable on the lathe. The hight of the tool on the lathe would be of much less importance if the tool could be readily pitched to correspond, and tools are notoriously used on the lathe at considerable disadvantage, on account of not being at precisely the best angle to the work.

This is the day of ball bearings, but I doubt very much whether we have yet come nearly to a full realization of their value and importance. They have vastly promoted the comfortable running of machinery, saving wear and saving power, and extending the possibilities of mechanical accomplishment. The stationary ball bearing has not as yet had very wide application. The adoption of spherical surfaces for many places where now flat or cylindrical surfaces are employed would do much to relieve the strains in many of our built-up structures. But that is going too far just now. I merely meant to suggest that probably the ideal lathe tool holder will have a spherical bearing that, within perhaps not a very wide range, will allow the tool to be set precisely as the best judgment would dictate and then enable the tool to be fastened or unfastened by a single screw.

Mr. Austin's letter opens a great many suggestive topics to the practical machinist. They all deserve discussion upon their merits, and there is not the slightest call for any perfunctory defense of any detail of American practice. Whenever we do not know the best way, it is our interest most of any to find out what is the best, and our best friend is he who will tell us.

MORRIS FULTON.

Philadelphia, Pa.

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Credit for Shop Improvements—Mysterious Explosions—Cutters for Boring Bars.

Editor American Machinist:

I suppose most of your readers noticed your remarks in issue of November 19, 1896, on the plan which a Baden manufacturer adopted for securing the co-operation of his workmen in improving shop methods, and also some pertinent thoughts on this question by Mr. W. H. Chappell, in issue of January 21st.

If it be true, and I think it is, that wide-awake workmen are more likely to discover short cuts in getting out work, than are the men in the designing room, or even the foreman, then why should anything prevent workmen from giving their employer the benefit of their skill?

I have seen enough of shop life to know that to secure the best of service, and that cheerfully, there must be a recognition of ability on the part of the "old man," as Mr. Chappell has it. Especially is this true when a foreman is unskilled as a workman, or too narrow minded to accord his men common justice and the respect due them.

I believe there is nothing, perhaps, that retards shop operations more than for a foreman to bother around the men too much, and thus interfere with their methods of doing things. When an intelligent workman says, "Don't you think, etc.," it will often be best to hearken to what he has to say. The little details in the machinist's work tend to inspire him with a lively interest in what he is doing. I have learned from experience that indifference to this fact, and the adoption of that false notion sometimes practiced, that men must be kept at arm's length, will very soon freeze out the last vestige of mechanical snap, and convert the men into mere automatons, with as little interest in their employers' welfare as the machine has, upon which they work.

I do not think the plan of handing in written specifications of improvements a good one, especially that feature of it which leads the contributor to expect compensation directly. If a thing assumes that much importance, the Patent Office affords the best means of protection from piracy. As for the ten thousand smaller affairs of the shop, it is enough that ingenuity and skill displayed be rewarded by a full and frank recognition, and I believe I am safe in saying that this is all that the machinist desires.

I have been expecting an explanation in the "American Machinist" of that "Mysterious Explosion," reported by Mr. C. C. Sprague in your columns of January 28th. It seems to me not so mysterious after all. Is it not probable that a quantity of water was forced into the plunger by the constant surrounding pressure of 100 pounds per square inch? and of course the inclosed air would be compressed to that extent, or perhaps to a pressure of thirty pounds, or more, per inch. If much more than this, the explosion would doubtless have been more violent, and would have taken place, perhaps, before all the cap screw had been taken from the flange. As for the gas explosion which followed, I am unable to explain this, but will venture a theory, whether right or wrong. This is, that hydrogen gas was set free inside the plunger by the oxygen attacking the iron, thus producing an explosive mixture which ignited when a lamp was brought in contact with it.

Mr. Sprague also asks about boring cylinders. There are few operations of machine tools more simple, as we all know, than that of boring cylinders, yet who has not been baffled in attempting to get what might be called a first-class job? I was taught in my early experience to use two or three cutters having rounded front edges gradually tapered back, so as to prevent having the feed show on the bored surface. To prevent chattering, a number of hard wood blocks were fitted to the head, and as the cut advanced these were shaved off to fit the bore; not infrequently this shaving operation was very unsatisfactory. I learned in the course of time that stiffness in the lathe and boring bar, was the essential thing in securing

rapid and good work in this line, and that a very smooth surface was not important, indeed not so desirable as a true one, which showed the feed distinctly. The only advantage, I think, in using more tools than one, is that their use may expedite the work somewhat.

While on this line I may notice the boring bars illustrated on the same page

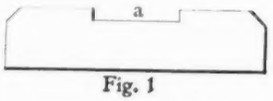


Fig. 1

Fig. 2

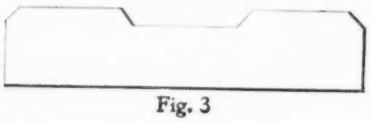


Fig. 3

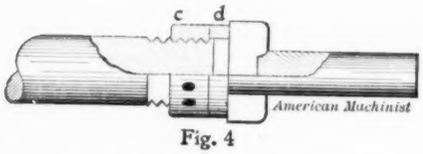


Fig. 4

HOLDING CUTTER IN BORING BAR.

with Mr. Sprague's, by Mr. F. J. Woodhurst. Objection is here made to a gibbed cutter of this form, Fig. 1; preference being given to the form Fig. 2. The trouble seems to be in the shape of the slot *a*. Of course, it will be difficult to preserve a fit with this form, but bevel the ends, as seen in Fig. 3, and the trouble is all over. This also admits of driving the wedge at the back instead of in front of the cutter, thus allowing a little more room for the wedge to come or go, and not interfere. But I have no use for wedges in a boring bar anyway, and believe it infinitely better to provide a binding nut, as shown by Fig. 4. This has the advantage of the cutter always being held perfectly square in the bar, and it dispenses with the use of a hammer, which is usually a mutilator of everything with which it comes in contact. This form of bar is of course intended for a hollow-spindled lathe. If the cutter is located at the end of the bar, it can best be held by a set screw, in the end of the bar. In Fig. 4 the loose collar *a* rests stationary against the cutter. This prevents the nut *c* from becoming worn on its edge, as it would be if allowed to bear on the cutter.

QUIRK.

▲ ▲ ▲

Counting Small Articles With Weighing Scales.

Editor American Machinist:

Small articles of manufacture, such as bolts, nuts or screws, may be rapidly and accurately counted in large quantities by means of a platform scale, if the construction of the machine is rightly understood.

The weights commonly bear two sets of marking, as shown in Fig. 1, the greater of which, as 100, 200, etc., indicates the amount on the platform which the weight "draws," while the lesser numbers, 1 pound, 2 pounds, etc., are the sealed weights of the castings, so that the ratio or multiplication of the scale can usually be at once determined. In this case, the ratio is 1 to 100, as 1 pound on the counterpoise will balance 100 pounds on the platform. Suppose, now, that we have a large quantity of special bolts to count, and we know the ratio of our scale to be 1 to 100. We have only to lay one of the

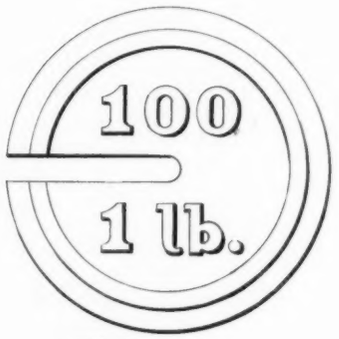


FIG. 1.

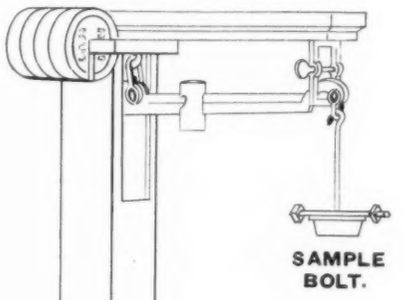
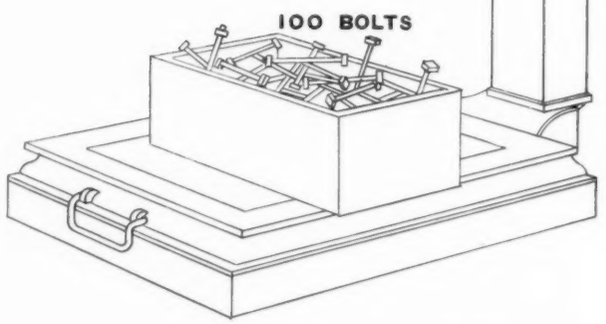


FIG. 2.



SCALES FOR COUNTING.

bolts on the counterpoise, as shown in Fig. 2, and pile enough of the remainder upon the platform to balance the scale, and we will find the number to be just 100. Five bolts will, of course, balance 500, or 10 bolts 1,000. We do not know how much they weigh, we only care to know the number. The tare of the box, or whatever contains the bolts, may be taken out by means of the usual weighing poise, which, in this case, has no other use. Scales of large capacity have a higher multiplication, so as to avoid handling a large number of weights; but there will always be a fixed ratio between the counterpoise and the platform.

W. H. SARGENT.

St. Johnsbury, Vt.

A Peculiar Method of "Feeding" Castings.

Editor American Machinist:

During a conversation on foundry practice with a foundryman from one of the mining districts in the State of California, the writer was interested in a description he gave of "feeding" castings with the rammer. As "feeding" castings with the rammer was a new wrinkle to me, and as I thought it would interest the readers of your valuable paper, I asked for a sketch of the castings referred to, which was kindly furnished, and the accompanying drawings are made therefrom. By way of explanation it might be well to say, that the castings are made from a very hard iron; generally white pig iron, or what is known as No. 6, which is at best a very unsatisfactory metal to work; owing to the nearly total absence of graphitic carbon.

The following extract from West's "Metallurgy of Cast Iron," is valuable to any person using the above grade of pig-iron: "Heavy-work founders and molders know that hard grades of iron shrink much more than soft grades, a fact for which no satisfactory explanation has heretofore been given. By recent expansion experiments, I have discovered that hard grades of iron expand more at the moment of solidification than soft ones. And there is a constant relation between this expansion and the preceding

shrinkage, which forcibly demonstrates the necessity of 'feeding' a casting to make its interior solid."

My friend thus describes his method of feeding with the rammer:

"I will first give you the model of a shoe, Fig. 2, which is round, and weighs 150 to 180 pounds. You will notice the swell or rounded parts *B B* on the bottom of the shoe; my sketch is upside down from the way they work, but shows the way they are cast. Now, here is where the feeding with the rammer comes in, and, if you run across any of this work, never attempt to feed it with a rod, as it would

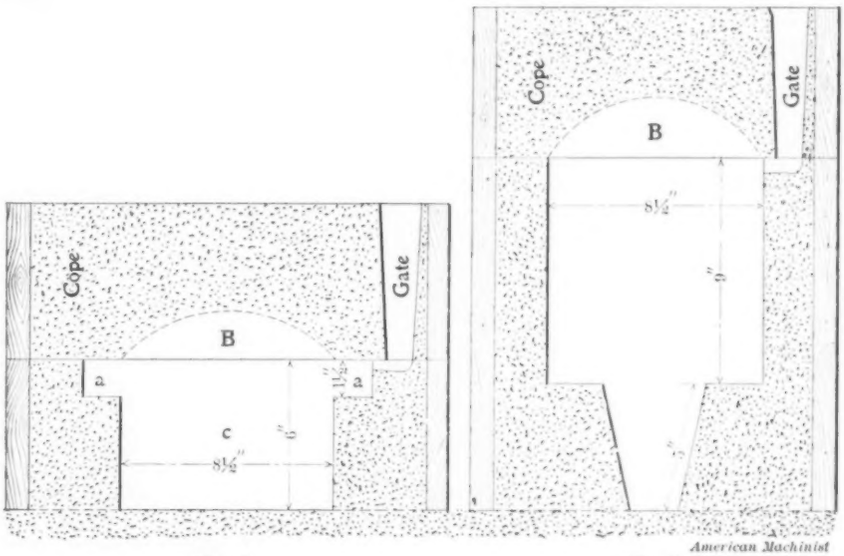


Fig. 1 Fig. 2

CASTINGS FED BY RAMMER.

just be like driving a steel pin into the shoe; for when it came to wear down it would not do so evenly, and consequently would do very bad work in the battery. So you take the cope off when the iron is still soft, and just before the setting point take a square nosed shovel, and rub down and scrape off until the casting is just about to become solid, then take a smooth butt rammer and set down the uneven places that may appear. Do not force with the rammer too hard, as the casting is liable to crack towards the outside. One very important part of this method of feeding is to lift the cope off at the right time; and nothing but experience and getting right into the harness will teach you this.

The dies (Fig. 1) are a little different in shape, but are proceeded with in the same manner as the shoes. The flanges *A A* are about 10 by 12 inches square, and 1½ inches thick, then comes the round working part *C*. Although those castings are comparatively heavy, we pour them with iron as hot as it can be melted, and find that by so doing the casting will wear near twice as long as when poured with dull iron."

GEO. O. VAIR.

Corning, N. Y.

Planer Elevating Screws.

Editor American Machinist:

We have been asked whether we do not think that the opposition make a very strong case in favor of both planer elevating screws being of the same hand as being cheaper in keeping up to a given degree of accuracy. If you assume that our extravagance in keeping our lead-screws up to standard, is incurred merely to guarantee the accuracy of our right and left elevating screws, then possibly we might cheapen same by adopting the other process. Such, however, is far from being the case.

All those who have expressed themselves in the "American Machinist" as opposed to right and left elevating screws, seem to take it for granted that all possible errors in accuracy of cross-rail alignment are due to that source. That is a great mistake. Among other causes of error might be mentioned: Loose fits, where the elevating screws have their bearings at top of uprights; untrue shoulders where the bevel gears bear on top of uprights; a bad tooth in either of the bevel wheels or pinions. Furthermore, some of the gears may be turned or cut on an untrue mandrel.

It may be cheaper to make both elevating screws one-hand, chase them on any old lathe, and let them go at that, and they might never cause any trouble; but it is much better practice to keep all the leading screws in the shop up to a certain limit of accuracy, because there are other screws on a planer which require accuracy, viz., the horizontal screw in cross-rail, which gives motion to the saddle; also the vertical feed screw in the swivel heads. These are frequently used for indexing work, and in every case where a long nut is used, it is absolutely necessary to have a uniform screw in order to get a good fit in the nut the whole length.

If, therefore, it is necessary to have accurate leading screws for some of the work, why is it not important to keep up the standard for all work, including elevating screws? Not that it is claimed that right and left elevating screws are better, but rather that they are as good as if both were right or both left.

You know that good work is sometimes cheaper than bad work, and that a slip-shod, haphazard habit in a factory is almost always disastrous in the end. It is much easier to control a shop when it is understood that nothing but first-class work will be accepted. It is not necessary that the legs of a machine be scraped to a surface plate where they join the bed, but it would be better for the discipline of the shop if it could be done.

THE G. A. GRAY CO.

Cincinnati, O.

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Flat Drills for Hard Steel—Rounding the Corners of Tools—Rolling Curved Chips, Etc.

Editor American Machinist:

Mr. C. L. Sharp, in the issue of March 18th, speaks of the flat drill as a superior tool for hard steel, which is certainly correct, as I can testify from continual daily experience in drilling hard tool steel. This brings to mind that Mr. Swift remarked in his letter of February 11th that he never saw anyone who thought it necessary to round the corners of a twist drill. In regard to this I would say I have done this often with perfect success, in fact always resort to this method when the ordinary fails. It certainly does seem reasonable that a sharp corner will not stand the wear that a round one will. The same is true of the lathe and planer tools he mentions in the same issue. Years ago I tried the straight face tool idea with a slightly rounded corner, but failed after many different trials and conditions, extending over two years, and concluded that the rounding of the tool was absolutely necessary for the quick removal of metal.

Again, in regard to bending of chips when tool is rounded, would say that if the section of chip was equal throughout its depth, it would be harder to bend or curl than the same section cut with a straight tool; but this is not the case, as the chip thins to zero, and at this point is weakest, and in the act of curling it expands, instead of compressing, as Mr. Swift would have it. But to return to the drill subject. Have recently drilled soft steel at the rate of 5⅝ inches diameter 18 inches deep per hour, and 6⅝ inches diameter 12 inches deep per hour. These were both flat drills run into the solid without previously drilling a smaller hole. The above was the limit of the drill and machine.

A. ALERTES.

Emsworth, Pa.

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Growth and Development of Machine Shop Practice.

A most difficult, if not an impossible task it would be to write a history of the progress in machine shop practice in the last half century. The progress has been continuous, and the sum of it is amazing, but it is not marked by many salient points upon which to fasten our attention. In this great age of progress the machinist has been well in advance, if he has not, indeed, led the procession. A procession it has been all along, with a steady, resistless sweep, and there have been few of the spurts of the helter-skelter race.

We may say that there has been no day in the last half century when the machine shop could not do more work, better work and cheaper work than the day before; and yet there has been no year when it would have been easy to state in detail in what it was superior to the year before. Nearly every machine tool in use to-day was in use in some form fifty years ago; but not one of them exists in the same form as fifty years ago, and yet the history of their transformation it would be impossible to produce.

The upright drill is one of the simplest and most widely diffused of machine tools, and it illustrates, perhaps better than any other, the progress which has been made, and the way in which it has been made. There are those who have thought it absurd, and have not hesitated to say so, that so many illustrations and descriptions of upright drills should appear in the mechanical journals. If there be anything wrong in this, we have in the past been pre-eminently guilty. But each successive drill that has been published has been so published because it had some claim to be in some way better than its predecessors. Not one of all the improvements successively developed, we may venture to say, was gotten up to fill the traditional special "long-felt want" for that particular thing. Every one was, however, gotten up to appease the continuous long-felt want to do work better, quicker, cheaper.

There has, perhaps, not been the improvement that might have been expected in the engine lathe. The principal things that have been done for it have been to make it stronger, to increase its wearing surfaces, and by excellent workmanship to make it true, accurate and reliable. The application and development of the turret has resulted in wonderful special machines that can scarcely be called lathes, and which yet steal from the lathe more than a half of its work.

The planer has been improved still less than the lathe, and it, too, chiefly in making it true and stronger. As the turret machines have robbed the lathes, so have the milling machines robbed the planers.

Beyond these changes, the progress of the machine shop has been more advanced by the development of the numerous small tools than even by the improvements upon the larger ones. As the upright drill has probably been more improved than either the lathe or the planer, so the small tools used in connection with it have been the especial field of the inventor. The introduction of the twist drill as an article of manufacture and supply is probably the most distinct incident of our progress.

The twist drill has been followed by the entire supply business, and that has developed the drummer, and if any influence deserves its word it is he, although he usually has words enough of his own. The drummer is a missionary, and is to be respected as such. He is a general disseminator of information as to the most advanced means and practices. He doesn't always understand very well what he is talking about, but he usually has his lesson well learned, and there are apt to be some ideas in it, wherever they may have come from. He carries the latest improvements, he is well filled up with the good points of his wares, and he compels his hearers to listen, often for their own good.

Of means and methods there is more to tell continually, and the knowledge of all that is new and good and profitable is continually more essential to success. The work of the technical or trade journal, as the recognized diffuser of the news of the trade, of its plans and its successes, was never more important; the man who failed to appreciate and who neglected its help was never more helpless.

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The Factor of Safety.

In every undertaking in every department of human activity the factor of safety plays an important part. In the weighing and determining of the means for the accomplishment of any given end, it is perhaps the most important of all. This is saying that all of our undertakings involve more or less of danger, not necessarily of life and limb, but at least of failure in the accomplishment of the purpose intended. The factor of safety comes in as an assurance of the probable adequacy of our provisions and precautions. In many, if not in most cases the factor of safety is the factor of success, and it is the one factor that must never be ignored.

There is undoubtedly in the factor of safety a suggestion of waste and extravagance. We first provide adequate means, which is absolute economy, and then the factor of safety insists upon a superabundance, which may be all unnecessary and ultimately count for nothing. The factor of safety is peculiarly the creature of circumstance. As the rate of interest, the money man's factor of safety, varies constantly with the certainty or the uncertainty of the financial transaction, so in engineering and mechanics the same fluctuations occur, and for similar reasons.

The factor of safety is always an assumed and arbitrary one, based not only upon widely varying conditions, and aiming to range as far, but also upon the ability or skill with which, or the completeness of the knowledge upon which, the conditions are estimated. It is determined by crude theory, whether the theory is consciously and clearly formulated or not. Theory is perhaps nowhere more apt to betray its incompleteness, and its consequent incompetence, than when fixing its factors of safety for any given case. The factor may be all sufficient under the assumed conditions, but if the assumptions have not as wide a reach as the facts, the factor of safety may, after all, be fatally deficient. It is in this direction that the factor of safety always fails, if at all. It can never guarantee too great safety, but too often secures too little.

The factor of safety, it must be confessed, fails in the thing it is intended to accomplish. It is a concession to uncer-

tainty, but it fails to eliminate it. We are still uncertain. Like the nut in a rattling machine that is apt to unscrew, we must fasten the nut with a set screw, and the set screw with a pin, and the pin with a spring, and so on, and still things may rattle loose and something may break, and the uncertainty remains.

The dual function of the factor of safety is another perplexity. It is used by the one who is assumed to know all that it is possible to know of the case, and its possibilities and requirements, to complete and amply fortify his estimates; but it is also the guarantee to him who knows perhaps nothing of the details or the unknown particulars or the uncertainties. The man of estimates may make up a number of different cases, giving every known detail its just value, and then after all he may assume in addition a factor of safety in one case of two, in another of five, and in another still higher. These things cannot fail to perplex the uninitiated, and leave the uncertainties still uncertain.

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The Battleship "Iowa."

The United States Battleship "Iowa" upon her recent official trial sustained a speed of 17 knots for the four hours' run, earning for the builders, William Cramp & Sons, a premium of $200,000.

The "Iowa" is somewhat larger than the "Indiana," her dimensions being: Length on load water line, 360 feet; extreme breadth, 72 feet 2½ inches; molded depth, 39 feet 4⅝ inches; mean draft, 24 feet; displacement on normal draft, 11,300 tons. The armament of the "Iowa" consists of four 12-inch guns, six 4-inch and twenty-two rapid fire and machine guns. The armor protection consists of a water-line belt of Harveyized nickel steel, 14 inches thick, on a 12-inch wood backing. This armor is 7 feet 4 inches wide and extends 186 feet amidship. The ends of this belt are joined by athwartship belts of 12-inch Harveyized nickel steel, worked diagonally from each side to a segment of a circle in the center corresponding with the radii of the superimposed redoubts. Forward and aft of the diagonal belts submerged protective decks extend to the ends, 2¾ inches thick on the flat. At each end of the armored citadel thus formed rises a circular barbette of 15-inch Harveyized armor, the after barbette being 8 feet 9 inches high, and the forward one 16 feet high. The turrets are armored with 14-inch plates.

The "Iowa" is the last of the premium-built battleships. The contract for her was awarded February 11, 1893. The contract price was $3,010,000.

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Permanent Machinery Exposition at Lima, Peru.

Washington, D. C., April, 1897.—Hon. Leon Iastromski, United States Consul at Callao, Peru, has forwarded to the State Department a translation of a decree providing for the establishment of a permanent exposition of machinery at Lima, Peru, as follows:

[TRANSLATION.]

Ministry of Public Works.

The President of the Republic:

Considering—

I.—That one of the means to promote the extension of the various branches of industry is to enable those engaged therein to obtain promptly a knowledge of the new machines and implements employed to produce articles of good quality at the lowest cost;

II.—That these ends can be attained by establishing a center where said machines, etc., can be constantly exhibited and where full information thereto may be obtainable by interested parties;

III.—That the Machinery Hall at the Palace of the Exposition, which has been placed at the disposal of the Minister of Public Works by the Provincial Council, is adequate and can easily be adapted to the purposes in view;

It is decreed—

I.—That a permanent exposition of all kinds of machinery shall be established at the said Hall;

II.—The said exposition shall be inaugurated on the 28th day of July, proximo;

III.—Imported articles destined for this exposition which are not exempted from duty, will have free despatch through the various custom-houses on the production of a bond guaranteeing the payment of duties ordinarily levied upon such articles, when they are not reshipped within the period of six months;

IV.—The exhibition of the same article shall not be allowed for more than six months without special permission from the government.

V.—The expenses for the preparation and permanent care of the hall shall be drawn from Clause No.... of the Budget in operation, and further provision shall be included in the next Budget;

VI.—The Minister of Public Works is charged with the execution of this Decree, and with the duty of prescribing the rules and selecting the employés required.

Given at the Government Palace, in Lima, February 27, 1897.

(Signed) N. DE PIEROLA,
MANVEL J. CUADROS.

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Bursting Test of a High-Pressure Boiler.

In St. Louis recently an interesting test was made especially to determine the comparative strength of a triple-riveted double-welt butt joint and a triple-riveted, single-welt lap joint, machine riveted, with rivets 13-16 diameter. The boiler was 60 inches diameter and 12 feet long, with 56 3½-inch tubes. The shell was ⅜ inch thick, and the heads ⅝ inch, the tensile strength being 60,000 pounds. The lap joint had a strap on the inside of the boiler, and the butt joint had straps both inside and outside.

Water pressure was applied, and at 750 pounds the double-welt joint weakened, and at 810 pounds it parted sufficiently to relieve the pressure. The shell under the 800 pounds pressure increased 5 inches in circumference and shortened 1 inch. None of the tubes were injured or leaked at any stage. Our particulars are obtained from "The Age of Steel," of St. Louis.

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Death of Mr. George Thompson.

Mr. George Thompson, of Brooklyn, whose improvement on micrometer calipers to facilitate reading sixteenths and thirty-seconds was published in our issue of Jan. 13th, died very suddenly on March 26th, of grip complicated with pneumonia, resulting in heart failure. Mr. Thompson was a man of reserved disposition, but highly thought of by those who knew him well. He was in the employ of the Domestic Sewing Machine Co. for seventeen years as tool and model maker, and occupied a similar position with the Standard Sewing Machine Company for five years. In connection with his work on sewing machines, he developed a system of broaches as a substitute for reamers in making standard size holes, shop rights for which were sold to several of the leading sewing machine companies. His death occurred in the sixty-first year of his age.

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The naval court of inquiry, recently convened at New York to investigate the circumstances connected with the failure of the machinery of the monitor "Puritan," completely exonerated Chief Engineer Farmer and all the officers of the vessel. The engines were clearly faulty in design, especially in the shaft bearings, which were insufficient for the weights to be carried. The engines were designed more than twenty years ago, and it would be unprofitable to go into ancient history.

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At the New Criminal Court Building, New York, the following examinations will be held: April 20th, at 10 A. M., for Engineer Inspector of paving, regulating, grading, etc., and on April 23d, at the same hour, for Assistant Engineer (civil) and Instrument Maker.

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It is not often that the burning out of a dynamo will save a man's life. This, however occurred recently in the State of Ohio. The dynamo to be employed in the electrocution of a murderer gave out in the preliminary trial, and the prisoner was given a respite.

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From May 10th to 14th the convention of the American Foundrymen's Association will be held in Detroit, Mich.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(43) H. L. McC., Cropsey, Ill., asks: What would be the expansion of a piece of iron 1 foot in length with a rise of temperature of 10° Cent.? Would there be any difference in cast or wrought iron? A.—The information here required is to be found in most of the "pocket books" of tables, and in various other places. The coefficient of expansion per unit of length is .00001 for cast iron and .00001166 for wrought iron, per degree Centigrade, within ordinary temperatures. The expansion of steel is nearly the same, but varies somewhat with its hardness. The coefficient above for cast iron is easily remembered and applied. A bar of cast iron, then, 12 inches long, whose temperature was raised 10° Cent., would expand: $12 \times 10 \times .00001 = .0012$ inch.

(44) W. H. B., Brooklyn, asks: 1. What are the standard widths across the flats of square and hexagonal heads of cap-screws, if there is such a standard? A.—The following has been published by three of the leading American machine screw companies:

Dia. of Screw.	Square Head—Short Dia.	Square Head—Long Dia.	Hexagon Head.—Short Dia.	Hexagon Head.—Long Dia.
¼	⅜	.53	7/16	.51
5/16	7/16	.62	½	.58
⅜	½	.71	9/16	.65
7/16	9/16	.80	⅝	.72
½	⅝	.89	¾	.87
9/16	11/16	.98	13/16	.94
⅝	¾	1.06	⅞	1.01
¾	⅞	1.24	1	1.15
⅞	1½	1.60	1½	1.30
1	1¼	1.77	1½	1.45

2. What are the best proportions for the thickness of babbitt and diameter of outside shell in babbitted bearings, either solid or made in halves? A.—The proportions will vary with the character of the service, and your observation will be a better guide than any data that we can at present furnish. Our columns treat of such matters at different times.

(45) P. E., Newton, N. J., asks: What power is there in a stream of water flowing through 300 feet of 1-inch pipe with 40 feet head? Would there be enough power to run four 16 candle-power lights? What would be the increase of power if the pipe was changed to 2 inches diameter? Is there any simple rule to compute this? A.—There is no simple rule. Using the table of the Pelton Water Wheel Company as a basis, we would figure it something like this: Allowing the water to flow through the pipe at the rate of 1 cubic foot per minute, the loss of head in the pipe itself would be about 15 feet, so that we would have only 25 feet head for the water when delivered. As a cubic foot of water weighs 62.35 pounds, we would have $62.35 \times 25 = 1{,}557$ foot pounds, of which perhaps one-half, or 778 foot pounds, might be developed by the water-wheel and connections actually employed. As a horse-power is 33,000 foot pounds per minute, and as a 16 candle-power lamp, roughly, takes one-tenth of a horse-power, or 3,300 foot pounds per minute, the power to be obtained from the water above would probably thus be less than one-quarter enough for one 16 candle-power lamp. With a 2-inch pipe, and other conditions as above, there would probably be about power enough for one lamp.

Personal.

Mr. C. A. Boyd, who has been connected with the Walker Company, Cleveland, O., for the past three years, has lately been appointed superintendent, with the entire active management of the engineering and manufacturing departments.

Carlton M. Williams, treasurer of the firm of Morse, Williams & Co., of Philadelphia, died at San Diego, Cal., on March 8th. The business arrangements of the company are not affected, as Mr. Williams had been unable to give his attention to such matters for some time.

Mr. F. C. Fladd, lately superintendent and secretary of the Stiles & Fladd Press Company, Watertown, N. Y., has left the employ of that company, and has accepted a position with the E. W. Bliss Company, 17 Adams street, Brooklyn, where he will be pleased to meet his many friends.

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"Marine Engineering" is a new monthly of which we have the first issue for April, 1897. It is filled with exceptionally interesting and valuable matter, and vindicates its right to be at the start, notwithstanding the multitude of so-called marine publications. If the standard of the first number is maintained, this publication will be an undoubted success. We are sorry that it is not standard size. Had it been, its filing and preservation would have been more probable.

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Commercial Review.

NEW YORK, SATURDAY EVENING, APRIL 10.

MILL AND MACHINISTS' SUPPLIES IN THE NEW YORK MARKET.

There are indications that during the four weeks now under review, business has shown some degree of improvement. It is true that trade is still very quiet, and dullness is the feature foremost in the minds even of many sellers who have some improvement to report. But it seems safe to say that there has been an actual forward movement, an increase of demand, compared with the state of things prevailing at the end of the winter.

The season, with its somewhat milder weather, is probably accountable for this, and for that reason it would perhaps be wrong to infer that much actual change in the undertone of business has taken place. Still, substantial improvement, when it comes at all, must do so by small beginnings, as was forcibly demonstrated to us, by way of contrast, in the boom that followed the last presidential election. If the little shoots of trade that are now starting up with the spring, are watered and nurtured carefully, they may grow hardy enough by midsummer to withstand the withering influences of that period.

The reports of slightly better business which we have heard are not those of one or two large concerns, but are received from a number of small houses doing a general business in mill supplies, agencies for single manufactories, etc., some of whom, for a long time past, have had none but discouraging news to relate. And that this class of sellers should be able to report a little improvement is, we should say, a particularly favorable sign. The opinions of some of the largest concerns, it is true, are a little depressing.

The demand for power transmitting machinery is improving and there are some good inquiries. A leading company engaged in this line of trade informs us that the business of the present year seems to have come a few weeks behind time. They say that there is not a great deal of important work, but that supplies furnished by them for a grain elevator in Buffalo and for a local equipment may be mentioned as of some magnitude. Another concern, who manufacture wood pulleys, have found the past few days rather slack, although the previous tendency of business had been upward.

Prices are still weak, as a general thing. We inquired of several sellers regarding them. One remarked that they had reached rock bottom, but that if anyone made an offer they went below. Another party said that prices have seemed rather steadier for the last ten days. A third authority who spoke from the standpoint of twist drills, etc., stated that within the last ten days or so prices had become stationary and that the next change would probably be a strengthening. A fourth party, also having twist drills especially in mind, said that it was not certain what concessions a large order would not bring out.

The head of one of the principal machinists' supply houses remarked to us that tariff matters are tending to strengthen the prices of those goods that are likely to be much affected by a revision of duties; such as nippers, pliers, files, measuring tape, chain, anvils, and steel. Those for which the American producers are more exclusively depended upon, such as twist drills, are not affected in this way, although the increased cost of steel will perhaps exert some influence upon the price of those articles which are made of it.

VIEWS OF VARIOUS AUTHORITIES.

The National Chuck Company did the best month's business during March that they have done since last October, foreign trade being especially good. For tapping chucks, a new specialty, the March orders were fifty per cent. greater than those of December, which was the best month up to that time. A symptom of the generally prevailing dull times of the past year, which they remark, is the unusual number of orders that have been received, connected with the repair of chucks, which in epochs of activity is considered a waste of time and labor.

Mr. J. D. Foot, of the Kearny & Foot

Company, file, rasp and twist drill manufacturers, is inclined to view the situation conservatively. Although the firm is, we presume, doing a fairly healthy business, as it usually is, it is considered unsatisfactory, compared with anticipations. Trade was marked by a slight flurry somewhat earlier in the year, but subsequently has tapered off. People are

(Continued on page 36.)

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Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Good gear cutter for sale cheap. B. V. Covert, Lockport, N. Y.

Engine Castings ½ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Send $1 to the Tabor Mfg. Co., Elizabeth, N. J., for improved stop-motion revolution counter.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

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Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday Morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

All-around machinist. Box 169, Am. Machinist.

A mech. eng., grad. of a Ger. univ., wishes pos. as draftsman; mod. sal. Box 170, Am. Mach.

Experienced mechanical draftsman desires position; 12 years' exp. Box 168, Amer. Machinist.

Designer and builder light automatic machinery, and special tools for wire and metal goods, wants position. "Reliable," American Machinist.

Foundry foreman—Position wanted by a sober, reliable man; 10 yrs. exp. as foreman on gen. mchy. & light bench work; good refs. Box 155, Am. Mach.

Expert on accurate and complicated work; exp. in the manuf. of tools, light machinery and specialties; is open for position as supt. or mas. mechanic. First-class ref. Box 167, American Machinist.

Mech. eng., 30, wide experience and education, mem. A.S.M.E., owns valuable pats. on gas engs. for direct cpld. elec. serv., desires con. with subtl. concern needing eng. or supt. Box 161, Am. Mach.

Sit. wanted as foundry foreman; 10 years' exp. A practical mold., acquainted with gen. work, both heavy and light; understands the mix. of irons and handling of men. Add. "Molder," Am. Machinist.

An expert mechanic, with large experience in designing and building special automatic machinery, tools, etc., will be open for engagement about May 1, where ability and faithfulness will be appreciated. Address Box 164, Care of American Machinist.

Wanted—Position by a man who has wide experience in bicy., mach. tool and gas eng. shops; am well posted on mod. methods of cheap production; can do drafting, etc. Have held posi as gen. supt. of a bicy. fact. for past 3 years. Can furnish best of ref. from past and pres. employers; West pref. Address "Camp.," care Braddock Mfg. Co., Burlington Wis.

Help Wanted.

Help Wanted—Good pay for leisure hours. Geo. W. Lord, Philadelphia, Pa.

Wanted—First-class tool maker, one used to die work. Apply, Ridgway Dynamo & Engine Co., Ridgway, Pa.

Wanted—Foreman brass moulder with thorough knowledge mod. fdy. requirements. Give experience, age and wages expected. Box 141, Am. Mach.

Wanted—Draftsman and designer; one used to mining and marine work. State experience, age and salary required. Address Box 151, Am. Mach.

Wanted—A salesman for presses and dies, sheet metal working mchs., special mchs. for bicycles; state full particulars. Box 158, Amer. Machinist.

Wanted—A foreman capable of handling from 20 to 25 men, thoroughly experienced in fine machine tool work. Address, The Davis & Egan Machine Tool Co., Cincinnati, O.

Wanted—Two draftsmen and designers; those who are familiar with 2-revoln. and stop-cylinder printing presses preferred. State ref. and salary expected. Address Box 165, American Machinist.

English Trade—Engineer and salesman (now in New York) well known in Great Britain, wishes to represent American mfr. of specialties in tools or machines; comsn. or salary. Box 166, Am. Mach.

Inspector—Wanted by Eng. firm man capable of inspecting and testing for finish and accuracy high-class machine tools. Applicants should have had experience of similar work in first-class shop, and must furnish satisfactory references. Reply, with fullest particulars, to Alfred Herbert, Limited, Coventry, Eng.

Wanted—A first class, sober, reliable field foreman, to build tanks, smoke stacks, water towers, etc. Must be capable of estimating costs on field work and keeping his labor within estimate. Would be located in New York and used in that city and surrounding territory. Address, stating experience, etc., Field Work, care Am. Mach.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S. M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Wanted—Corliss Eng., 50 to 60 h. p.; second hand; in good condition. Add. Box 171, care Am. Mach.

Models, experimental and small special machy. built. Write to Crocker & Lawson, Binghamton, N. Y.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Wanted—Every reader of this paper to send 35 cents for The Tool Catalogue. See Montgomery's advertisement on page 14 of this edition.

Model Locomotives—Complete castings, latest N. Y. Cen. standard, up to date; 4c. in stamps for catalog. G. H. Olney, 163 Herkimer St., Brooklyn, N. Y.

For Sale—Thompson Steam Engine Indicator; good as new, with two cocks and two springs; all in mahogany case; cheap for cash. "Indicator," American Machinist.

Wanted—An Idea. Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.

Columbia University
in the City of New York.

SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
SCHOOL OF ENGINEERING,
SCHOOL OF ARCHITECTURE,
SCHOOL OF PURE SCIENCE.

Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded on application to the Secretary of the University.

DRAFTSMAN'S
HANDY PROTRACTOR.
AND OTHER NEW CONVENIENCES.
SEND FOR CIRCULARS.
D. J. KELSEY,
NEW HAVEN, CONN.

WILSON IMPROVED IRON PLANERS.
STANDARD SIZES KEPT IN STOCK. BY W. A. WILSON RIVER ST. ROCHESTER N.Y.

GOOD BOOKS.

GAS, GASOLINE AND OIL ENGINES

By GARDINER D. HISCOX, M. E.

The only American book on an interesting subject. 279 large pages, 8vo, illustrated with 206 handsome engravings. **$2.50.**

Full of general information about the new and popular motive power, its economy and ease of management. Also chapters on Horseless Vehicles, Electric Lighting, Marine Propulsion, etc.

SPECIAL CHAPTERS ON

Theory of the Gas and Gasoline Engine, Utilization of Heat and Efficiency of Gas Engines, Retarded Combustion and Wall Cooling, Causes of Loss and Inefficiency in Explosive Motors, Economy of the Gas Engine for Electric Lighting, The Material of Power in Explosive Engines, Carbureters, Cylinder Capacity, Mufflers, Governors, Igniters and Exploders, Cylinder Lubricators, The Measurement of Power, The Indicator and its Work, Heat Efficiencies, U. S. Patents on Gas, Gasoline and Oil Engines and their adjuncts since 1875, etc.

THE MODERN MACHINIST

By JOHN T. USHER, Machinist. Second Edition. 257 Engravings. 322 Pages. **Price, $2.50.**

A new book from cover to cover. It contains everything that the up-to-date machinist should know about his business. Practical, instructive, exhaustive. A valuable addition to the library and a reliable text-book for the machinist.

"SHOP KINKS."

By ROBERT GRIMSHAW, M. E. Nearly 400 Pages. **Price, $2.50.**

It shows special ways of doing work better, quicker and cheaper than usual. It is full of pointers as to how work is done in the best American and European shops. It bristles with valuable wrinkles and helpful suggestions. It will benefit all, from apprentice to proprietor. Every machinist, at any age, should study its pages. It contains 222 illustrations, most of them directly contributed by eminent constructors. Every machinist needs it.

***Any of the above books sent free on receipt of price. Our large Catalogues embracing works on every practical subject, also a special circular of any of the above books, mailed free, on application.

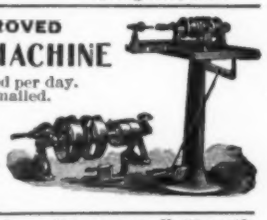
NORMAN W. HENLEY & CO., Publishers,
15 Beekman Street, NEW YORK.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

J. M. ALLEN, President.
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary and Treasurer.

Automatic Solid Die Bolt
THREADING MACHINES.
Two Styles. Four Sizes.
Send for Catalogue "A."
Webster & Perks Tool Co.
Cor. Spring and Monroe Sts.,
Springfield, Ohio.

NEW IMPROVED
TAPPING MACHINE
25,000 holes tapped per day.
Description mailed.
Machinery and Tools.
Brass Machine Screws.
HARVEY HUBBELL,
33-35 Organ St.,
Bridgeport, Conn.



We Make Boring Machines, Milling Machines, Special Tools Beaman & Smith PROVIDENCE, R. I.

(Continued from page 35.)

buying only to meet actual requirements, and jobbers seem to be deterred from placing orders by the inaction of retailers.

Mr. C. C. Clarke, a member of the Allerton-Clarke Co., general Eastern agents for the Arcade File Works, informs us that March has been found the best month for a year past. The factory is now running full force, full time. Although some stock is being accumulated, they expect to find a market for it eventually, and the demand is now working well up toward the production point.

Patterson, Gottfried & Hunter, who carry on an extensive trade in supplies and hardware, inform us that at present store business is quieter than it was during the winter, but that out of town business is good, March being better than February. It is according to the ordinary course of things, they find, that business is a little slack during the first few days of a month.

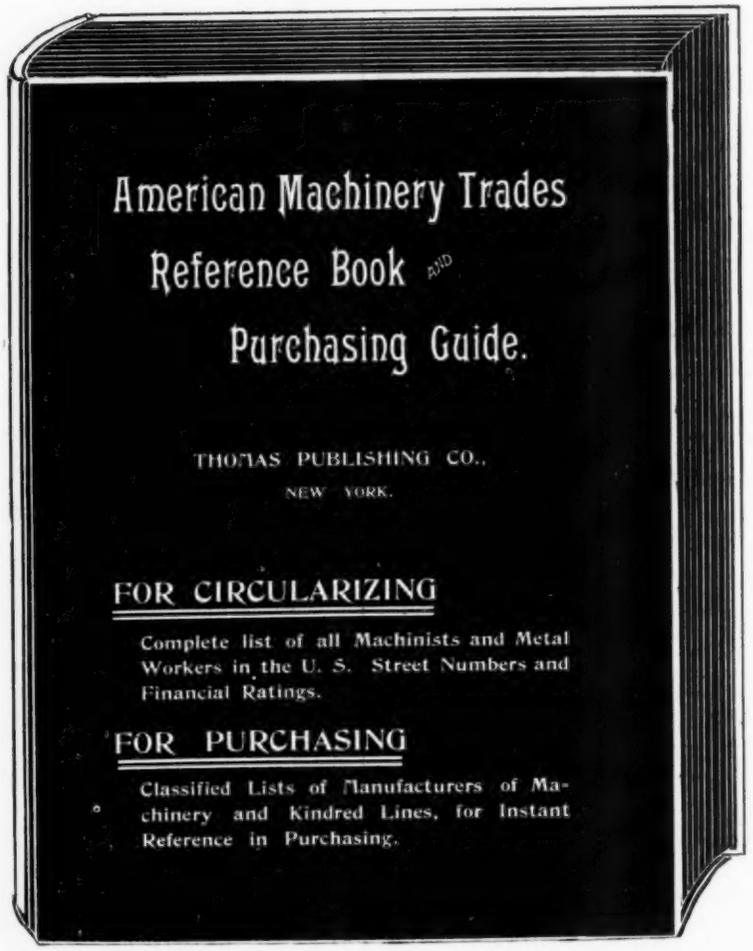
Peter A. Frasse & Co. inform us that March was a notably good month, and it is perhaps because of the contrast that they consider April rather dull.

ELECTRIC RAILWAYS ABROAD.

The American companies which manufacture electrical machinery for street railway purposes are limited to a few, but they include our largest in the dynamo and motor business. The export trade in this line, especially to Europe, as we have frequently stated before, is good. Some electric railway work is now being undertaken in the Spanish cites of both continents. The cities of Granada and Cordova, Spain, are proposing to install such systems, and will consider offers from American sources; some members of the Spanish Club, St. Louis, Mo., evidently acting as intermediaries. The fact that Spanish cities are willing to look to this country at a time when the Anti-American feeling in Spain is so strong as at present—such names as Sherman and Morgan being commonly bestowed on cur dogs and swine destined for the slaughter—would seem to indicate the reputation for merit and the almost indispensability which American electrical machinery is earning.

On the American Continent, in Buenos Ayres, the first electrical railway in the Argentine Republic is being commenced. The concession for the road was obtained by a company organized in the United States. Twenty-six miles of road are in contemplation, to be equipped with double decked cars, propelled each with two 25 horse-power motors, geared to the axles of the two bogeys carrying the frame of the cars. The plant will include four Stirling water tube boilers, aggregating 950 effective horse-power, with three high-speed vertical compound Ball & Wood engines, of 450 horse-power each, directly connected to 300 kilowatt continuous current Walker dynamos.

(Continued on page 37.)


American Machinery Trades
Reference Book AND
Purchasing Guide.
THOMAS PUBLISHING CO.,
NEW YORK.
FOR CIRCULARIZING
Complete list of all Machinists and Metal Workers in the U. S. Street Numbers and Financial Ratings.
FOR PURCHASING
Classified Lists of Manufacturers of Machinery and Kindred Lines, for Instant Reference in Purchasing.

HUB THRUST BEARINGS.

They Kill Friction.
They Save Oil.
They cannot Heat,

They will Run at any Speed.
They will Carry any Load.
They are Durable.

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SEND FOR ILLUSTRATED CATALOGUE.

10 Watson Street, BOSTON, MASS.

"THE WORLD'S BEST."

THE PANCOAST VENTILATOR.

HANDSOME, STRONG, DURABLE, EFFICIENT.

Leads them all in giving the best of Ventilation.

Houses, Mills, Factories, School-Houses, Churches, Refineries and *Founderies* use them with perfect results.

Architects in preparing plans for buildings should always specify the *Pancoast Ventilator.*

PANCOAST VENTILATOR CO., Inc., Manufacturers,
Offices, 316 Bourse Building, Philadelphia, Pa.

United States, Canadian and Foreign Patents.

This is the SPINDLE BEARING found to be the BEST so used on the FITCHBURG LATHE.

FITCHBURG
MACHINE WORKS,

FITCHBURG, MASS., U. S. A.

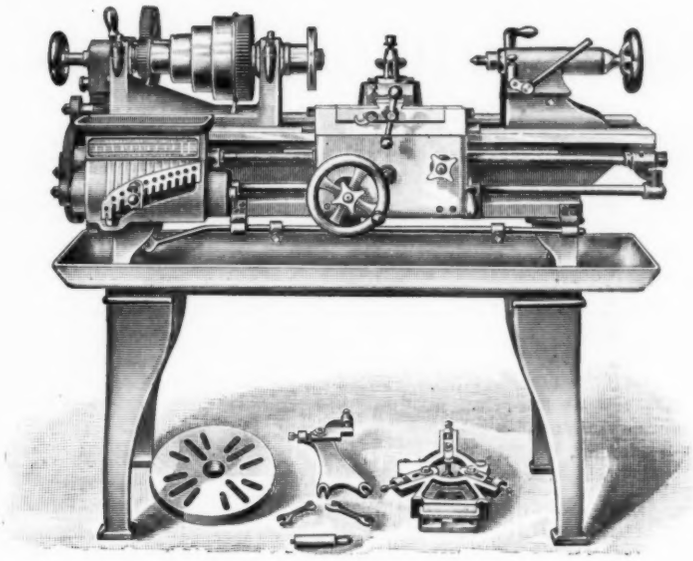
Our Lathe features the best,

CHAPMAN FEED (Pat. Aug. 18, '96.)
AUTOMATIC STOP FRICTION (Pat.)

FINE WORKMANSHIP. BEST MATERIALS.

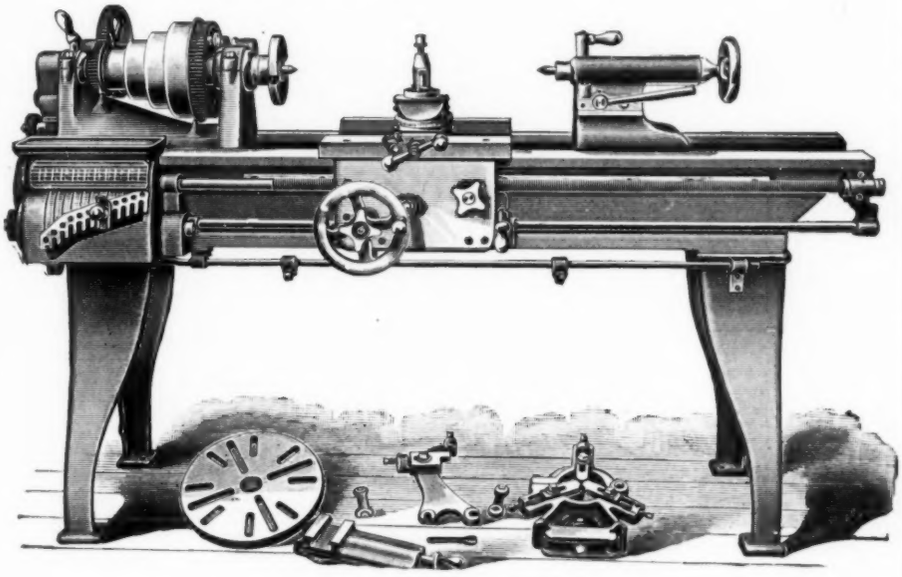
Other Metal-Working Machinery.

Future Ads. will surprise you.



12" Hendey-Norton Lathe

is fitted with drawing-in sleeve and American Watch Tool Co's standard chuck, used in making small taps, reamers, etc. Work finished first and cut from bar afterwards. No centering required. See carriage reverse lever by right-hand side of apron; no reaching for countershaft shipper required.



14" x 6' Hendey-Norton Lathe.

These lathes are modern, high-grade, practical tools, and are specially adapted for tool-room work. They have the Norton Attachment for screw cutting, giving 36 different threads and 36 different feeds with only two changes of gear and movement of lever in gear-box from one notch to the other. Note the automatic stop under apron. It will automatically stop carriage at any desired point in either direction; invaluable for internal or duplicate work. SEND FOR CATALOGUE.

The Hendey Machine Company,
Torrington, Conn.

Agents for the Pacific Coast, Pacific Tool & Supply Co., San Francisco, Cal.

European Agents: { Chas. Churchill & Co., London and Birmingham, Eng.
Schuchardt & Schutte, Berlin and Vienna.
Eugen Soller, Basel, Switzerland.

(Continued from page 36.)

Quotations.

NEW YORK, Monday, April 12.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 00 @ $12 50
No. 2 foundry, Northern	11 25 @ 11 75
No. 2 plain, Northern	10 50 @ 10 75
Gray Forge	10 25 @ 10 50
No. 1 foundry, Southern	11 00 @ 11 25
No. 2 foundry, Southern	10 25 @ 10 75
No. 3 foundry, Southern	10 00 @ 10 25
No. 1 soft, Southern	10 50 @ 10 75
No. 2 soft, Southern	10 25 @ 10 50
Foundry forge, or No. 4, Southern	9 75 @ 10 25

The lower figures quoted are said to be under the general market.

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.00 @ 1.10c.; refined, 1.10 @ 1.25c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.35 @ 1.50c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some brands perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel — Ordinary brands, from store, in small lots, 1.50 @ 1.60c.

Cold Rolled Steel Shafting—Base size, 2.50 @ 2.55c., in small lots, from store.

Copper—Carload lots, Lake Superior ingot, 11½c.; electrolytic, 11 @ 11¼c.; casting copper, 10⅞ @ 11c.

Pig Lead—In carload lots, 3.32½ @ 3.35c., f. o. b., New York.

Pig Tin—For 5 and 10-ton lots, 13.30 @ 13.40c., f. o. b.

Spelter—In carload lots, New York delivery, 4.10 @ 4.15c., f. o. b.

Antimony—Cookson's, 7¼ @ 7½c.; Hallett's, 7c.

Lard Oil—Prime city, present make, commercial quality, in wholesale lots, 39 @ 41c.

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Manufactures.

At Pittsburg, Pa., Wolf Bros. are erecting a brush factory.

At Uniontown, Pa., a new radiator factory will be erected.

The Fredonia Mill at Shirley, Mass., was recently gutted by fire.

The Glennon Mill at Pittsfield, Mass., will place new machinery.

J. C. Wall, of Bridgeport, Conn., intends to install new machinery.

Messrs. Funk & Plottner, of Findlay, O., are enlarging their factory.

At Bloomsburg, Pa., Mr. L. H. Wolfe is erecting a match factory.

The Lawson Manufacturing Company has been organized at Madison, Wis.

A new mill is being erected at Providence, R. I., and Mr. J. P. Bodge is interested.

At Philadelphia, Pa., Mr. Gibson MacIlvane contemplates the erection of a planing mill.

The plant of the Poland Paper Company, at Gilbertville, Me., was destroyed by fire lately.

The St. Louis & Meramee Railroad Company is to build a new repair shop at St. Louis, Mo.

The Wellman Steel Company, of Chester, Pa., will make a large addition to their plant.

The Eagle Electric Works, of Peoria, Ill., are erecting a new factory at Washington, Ill.

The planing mill of J. H. Burt & Co., Mattapan, Mass., has been totally destroyed by fire.

The Belden Machine Company, New Haven, Conn., will remove their plant to Westville, Conn.

At Mexico City, Mex., the Kingsland Manufacturing Company will erect a glass-making plant.

The Midvale Steel Company, Philadelphia, Pa., will erect a new electric light and power station.

The Robinson Company, Seattle, Wash., has in contemplation the erection of a new smelter.

The plant of Bedard & Morency, Chicago, Ill., which was recently destroyed by fire, will be rebuilt.

The Dickson Roller Mills, of Nashville,

Tenn., contemplate the installation of new machinery.

At Bay Ridge, Brooklyn, N. Y., the work on the Edison electric-light plant has been commenced.

The New Bedford Manufacturing Company, New Bedford, Mass., will increase their plant considerably.

The Fostoria Glass Company, of Moundsville, W. Va., are making extensive additions to their plant.

The Union Compress Company, of Memphis, Tenn., will soon commence the erection of a new compress.

The Consolidated Traction Company contemplate the erection of a new power house at Pittsburg, Pa.

The Hamilton Iron Company, of Superior, Wis., has been organized. Incorporators, A. C. Titus, J. R. Hill.

The Toledo (O.) Brazed Fork & Tube Company has been recently organized. Mr. John B. Winslow, of Findlay, O., is manager.

The Barr-Fyke Machine Company, of Kansas City, Mo., has been organized. Incorporators: Walter Scott, J. H. Barr and M. A. Fyke.

The Golding Kaolin Company, of East Liverpool, O., and Trenton, N. J., has decided to erect a new plant at Wilmington, Del.

A new company, under the title of the Castalia Cement Company, has been organized at Sandusky, O. They have secured 375 acres of land, and the plant, it is estimated, will cost about $150,000.

The Portland Company, Portland, Me., recently shipped parts for five pulp digesters to Japan. The same company have also supplied all the phosphor bronze work required for these digesters.

The Standard Oil Company are about to erect, at Bayonne, N. J., a boiler shop 300 feet long and 105 feet wide. The main portion of the shop is divided into three bays. The steel work was designed and will be erected by the Berlin Iron Bridge Company, of East Berlin, Conn.

The United States Consul at Tientsin, China, has called attention to an opening in that city for American made fire engines; also that new car works are to be established at Lu Kou Chiao, the engineer of which will be U. V. Kinder, Tongshan. Saw and planing mill machinery will also be wanted at the same place. A coal mine is being opened by the Chinese Engineering & Mining Co., of Tongshan, who are sinking a 20-foot shaft to a depth of 1,300 feet. The engineer of this enterprise is H. Michaelis. The Consul suggests that fully priced catalogs be sent by manufacturers desiring to enter this market.

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New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

Tower & Lyon, New York, N. Y., send us a catalog containing illustrations and descriptions of machinists' tools. It is 4¼ x 8¾ inches.

A. M. Scheffey & Co., New York, N. Y., send us a catalog of the "Wynnewood" bicycle. It is 6 x 7¾ inches. Accompanying this is catalog No. 6 of bicycle sundries and specialties.

The Smith Premier Typewriter Company, Syracuse, N. Y., have issued a catalog devoted to the description and illustration of new model typewriters. The catalog is 7¾ x 8 inches.

We have received from Dietz, Schumacher & Boye, Cincinnati, O., a catalog, in which are described lathes, screw machines, drills and other machine tools. The catalog is standard size, 6 x 9 inches.

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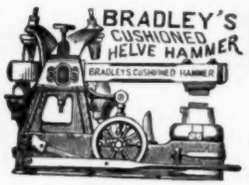

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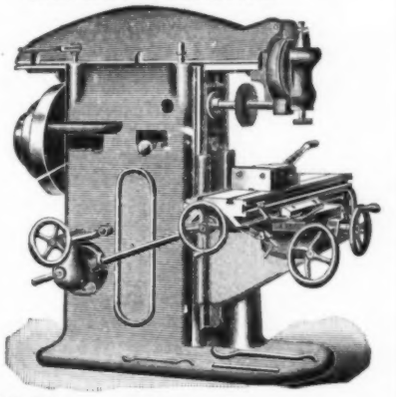

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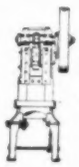

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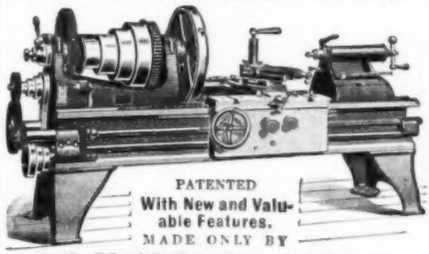

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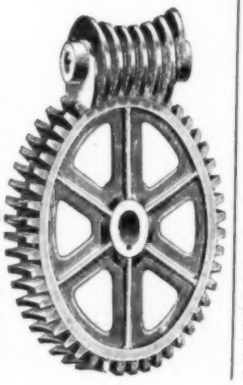

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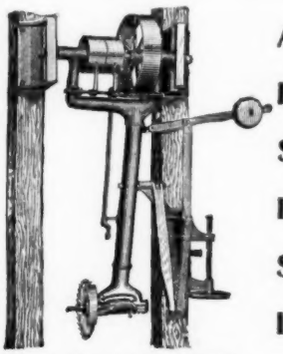

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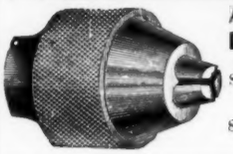
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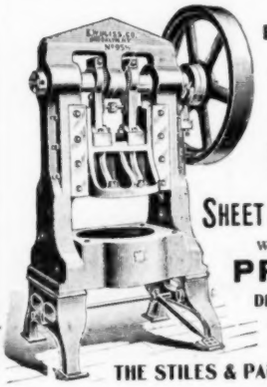
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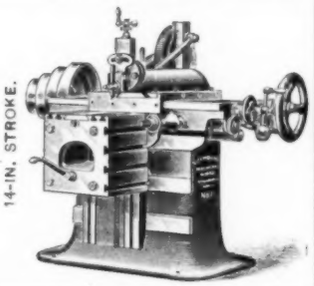

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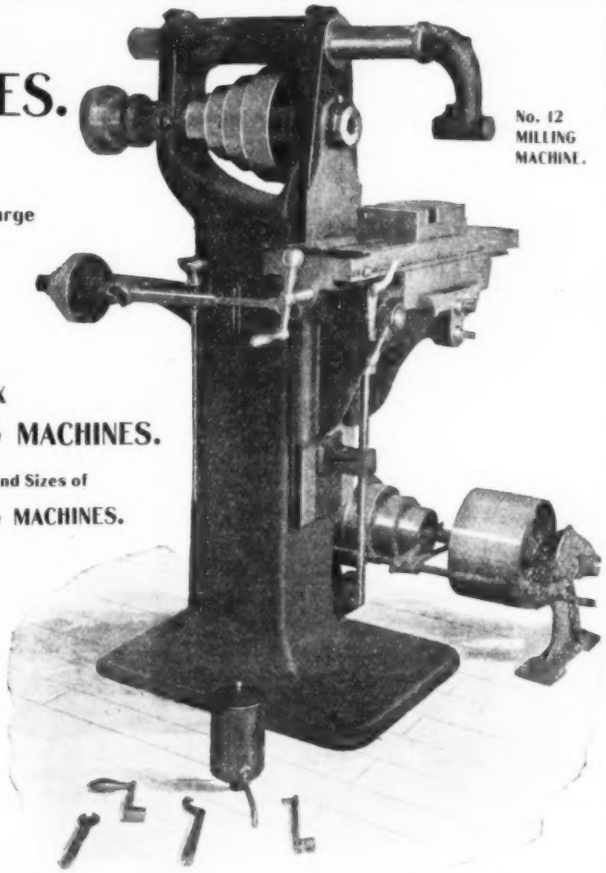

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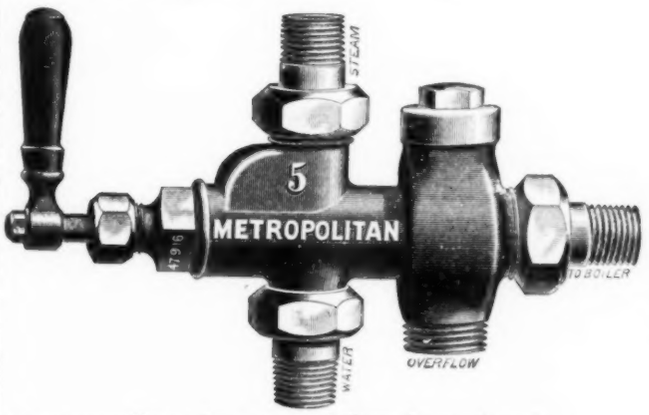

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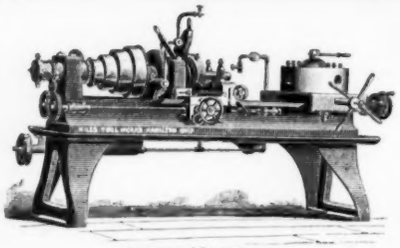

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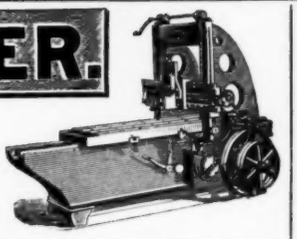

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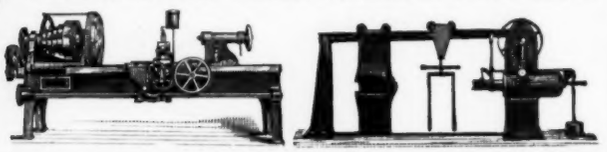

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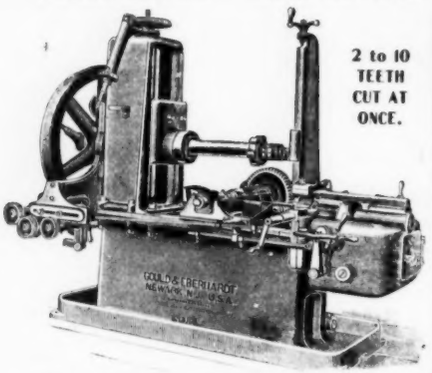

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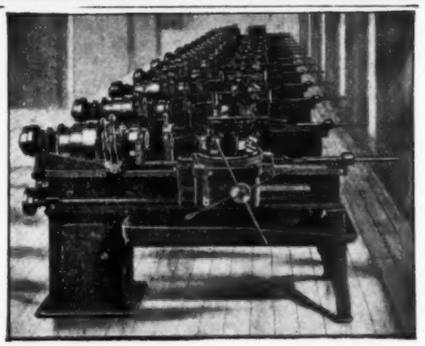

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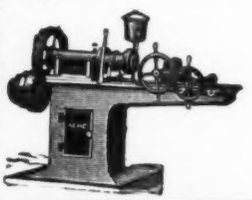

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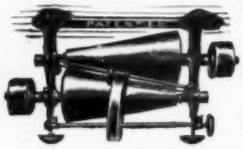

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